

UNDERSEAWARFARE

U. S. S U B M A R I N E S... B E C A U S E S T E A L T H M A T T E R S

Global REACH

U.S. Submarine Force Extends its
Dominance Through Innovation
and Advanced Capabilities



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Comms at Speed and Depth

USS *Ohio* Returns to Service

USAF, USN Test SSGN Capabilities

Diesel Electric Submarine Initiative



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UNDERSEAWARFARE

THE OFFICIAL MAGAZINE OF THE U.S. SUBMARINE FORCE

Global REACH

U.S. Submarine Force Extends its Dominance Through Innovation and Advanced Capabilities

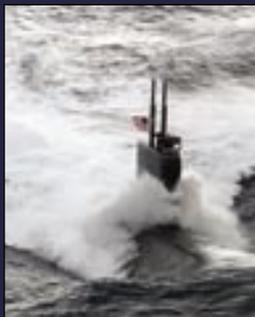
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On The Cover



The *Los Angeles*-class fast attack submarine USS *Asheville* (SSN-758) underway conducting high-speed surface drills off the coast of Southern California. *Asheville* is assigned to Submarine Squadron ELEVEN and is homeported at Naval Base Point Loma, Calif.

Photo by Petty Officer 2nd Class Scott Taylor



We continue to innovate and push the technology envelope with state of the art communications systems to give our submarines the capability to communicate with other forces at tactically useful depths and speeds.

RADM Joseph A. Walsh, USN, Director, Submarine Warfare

This past April we celebrated the 106th birthday of our Submarine Force. I am confident that submariners around the globe celebrated and reveled in our storied past and the rich legacy of those who have gone before us. Keeping in mind those submariners who have gone before us, my Deputy, Rear Admiral Mike Klein, had the honor of being the keynote speaker at the Submarine Service Wreath Laying Ceremony, held annually at the Navy Memorial here in Washington, DC to recognize those submariners who remain on “eternal patrol.” For those of you who were unable to attend this ceremony, I ask that you take a moment to savor our history, and remember those who have rendered the highest service any American can offer to our nation.

Today, our Submarine Force continues this legacy along with the innovative spirit of men like Admiral Eugene B. Fluckey and the crew of USS *Barb*. The *Barb* is credited with being the first submarine to destroy enemy supplies and coastal fortifications with submarine launched rocket attacks, and who later, inserted an eight-man “SOF” team onto the shores of the Japanese homeland to destroy a coastal supply train. It is with this spirit we have returned to service our first modern-day “*Barb*” – USS *Ohio* (SSGN-726), whose strike, SOF and expansive payload capabilities will dramatically increase the range of missions our Submarine Force can accomplish. Additionally, USS *Florida* (SSGN-728) was delivered back to the Navy on April 8, 2006.

Over the next several months, we will continue to test and evaluate *Ohio* and *Florida*'s SOF and strike missions, and their future capabilities. Exercise MIGHTY MALLETT, a recently completed exercise to test one of these future capabilities, evaluated the viability of deploying Air Force Para-Rescue Jumpers (PJs) from SSGNs on downed pilot rescue missions using USS *Alabama* (SSBN-731) as an SSGN-surrogate. You can read more about this exercise on page 4 of this issue.

We continue to innovate and push the technology envelope with state of the art communications systems to give our submarines the capability to communicate with other forces at tactically useful depths and speeds. An in-depth technical discussion of the advances related to communications at speed and depth can be found on page 8.

Today, nearly forty countries possess diesel-electric submarines. As the sophistication, endurance, and quieting of these submarines improve, so must our understanding of

their capabilities and tactics. To this end, the Diesel Electric Submarine Initiative (DESI) was established to give our submarine crews the opportunity to train with modern, quiet diesel-electric submarines – the type of force we would potentially face in a future conflict. However, we are not the only ones who benefit from this partnership. Our submarine allies, such as Peru and Colombia, gain invaluable training through sub on sub exercises, and post exercise reconstruction and analysis. An insightful report on the DESI project can be found on page 18.

You will find an overview of the office of the Oceanographer and Navigator of the Navy on page 21. From this office, Rear Admiral Fred Byus provides our forces with the oceanographic and navigation tools needed to successfully operate in the maritime battlespace.

Finally, on page 24, UNDERSEA WARFARE Magazine takes a look at *Alligator*, an attempt by the U.S. Navy during the Civil War to field its first operational submarine. *Alligator* has been overshadowed by the more famous CSS *H. L. Hunley*, and for a time, was nearly forgotten by all but a few dedicated naval historians. The Office of Naval Research and the National Oceanic and Atmospheric Administration's Office of National Marine Sanctuaries have rekindled interest in this elusive submarine, and having been working hard to locate its final resting place.

On a personal note, I would like to wish “fair winds and following seas” to LCDR Wayne Graddock, the former military editor of this magazine. He will report as Executive Officer of USS *Nebraska* (SSBN-739)(BLUE) after completing the Submarine Command Course.

As the Silent Service presses on through this transformational year, it is important to take a step back and appreciate – even if just for a moment – the fantastic job our Sailors are doing in support of the safety and security of our Nation.

BZ to each and every one of you, and happy 106th birthday to the U.S. Submarine Force!



Undetected and persistent, our crews gathered knowledge, supported Strike Groups or worked with allied forces in rigorous exercises. I am proud that the Submarine Force continues to draw praise from theater commanders for the value we bring to the table.



VADM Chuck L. Munns, USN, Commander, Naval Submarine Forces

Greetings to the Undersea Enterprise and a Happy 106th birthday to the Submarine Force! We continue to be busy in oceans and littoral waters around the world. Since the turn of the year we have conducted sea trials for USS *Ohio* (SSGN-726) and USS *Florida* (SSGN-728), sent 13 SSBNs on patrol, deployed eight SSNs and returned seven from deployments. These submarines either tested and validated conversion design and shipyard work, kept our nation safe with the most survivable form of deterrence, or served as scouts going where others cannot.

Our returning SSNs this year have covered a lot of global territory and operated in challenging environments – often in shallow waters with dense merchant or fishing traffic. Undetected and persistent, our crews gathered knowledge, supported Strike Groups or worked with allied forces in rigorous exercises. I am proud that the Submarine Force continues to draw praise from theater commanders for the value we bring to the table.

By now you all should be more familiar with our Enterprise structure and functions. This has been a topic of discussion during the Waterfront 1120 Calls I've held at nearly every submarine homeport in the past months. For those who were unable to attend one of these briefs, you should familiarize yourself with the USE overview posted on the SUBLANT and SUBPAC websites <www.sublant.navy.mil and www.csp.navy.mil>. Understanding the big picture of how we are organized as an enterprise and your role in its success is important. It is also important that you act as an undersea expert when you are in billets outside the submarine force. The dolphins you wear represent not only your professionalism but also that of the entire submarine force – past, present and future.

A Bravo Zulu is due to RDML Frank Drennan, his Group NINE staff, the CO and crew of *Ohio*, and the Naval Base Kitsap-Bangor team who did a magnificent job putting on the SSGN Capabilities Symposium and Ohio Return to Service in February. The turn out was great – from the joint Special Operations Forces, the local community led by Congressman Norm Dicks, industry representatives, the ship's sponsor Mrs. John Glenn, to our guest speaker Vice Chairman Joint Chiefs of Staff ADM Ed Giambastiani.

ADM "G" is in many ways the patron saint of the SSGN program because of his significant role in developing and realizing the SSGN concept. As he stated during the Feb. 7 ceremony, and as he later reported to the president, "The SSGN has truly been a case study in transforming our military capabilities to meet the future needs of our joint forces. It provides exactly the kind of capabilities our Quadrennial Defense Review calls for."

In support of sustaining readiness, the 2006 Quadrennial Defense Review (QDR) calls for the Fleet to have greater presence in the Pacific Ocean, consistent with the global shift in trade and transport. For the Submarine Force, this means shifting our SSNs for a composition of 60 percent in the Pacific and 40 percent in the Atlantic. We plan to make these moves by 2010. These homeport shifts will impact some of our people and their families. While these transitions take energy and cause stress, they also provide adventure and produce opportunities. Two of the boats transitioning last year made arctic transits... surfacing way up north. Not many people in this world have played softball with Santa at the North Pole.

With regards to our future force, the QDR calls for a return to a steady-state production rate of two nuclear attack submarines per year not later than 2012 while achieving an average per-hull procurement cost objective of \$2.0 billion (fiscal year 2005 dollars).

The Undersea Enterprise is working on a strategy to reach that price. We base it on three pillars: multi-year contracting, shipyard construction efficiencies, and redesign for capability enhancement with cost reduction.

Initiatives like these, along with the work you all do every day, are key to enhancing Submarine Force contributions to our National Security.

Keep up the good work in your respective part of the Enterprise! Smooth sailing, and good hunting.



The Official Magazine of the U.S. Submarine Force

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Commander, Submarine Force, U.S. Atlantic Fleet

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UNDERSEA WARFARE is the professional magazine of the undersea warfare community. Its purpose is to educate its readers on undersea warfare missions and programs, with a particular focus on U.S. submarines. This journal will also draw upon the Submarine Force's rich historical legacy to instill a sense of pride and professionalism among community members and to enhance reader awareness of the increasing relevance of undersea warfare for our nation's defense.

The opinions and assertions herein are the personal ones of the authors and do not necessarily reflect the official views of the U.S. Government, the Department of Defense, or the Department of the Navy.

Contributions and Feedback Welcome

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In keeping with UNDERSEA WARFARE Magazine's charter as the Official Magazine of the U.S. Submarine Force, we welcome letters to the editor, questions relating to articles that have appeared in previous issues, and insights and "lessons learned" from the fleet.

UNDERSEA WARFARE Magazine reserves the right to edit submissions for length, clarity, and accuracy. All submissions become the property of UNDERSEA WARFARE Magazine and may be published in all media. Please include pertinent contact information with submissions.

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dear EDITOR,

Your outstanding article "Sea Predator – A Vision for Tomorrow's Autonomous Undersea Vehicles" [UNDERSEA WARFARE, Winter 2006] is both powerful and timely – joining together the submarine community and the mine warfare community as a great team for highly effective undersea warfare for the 21st Century!

I hope our great submarine Sailors make Sea Predator a winner for Sea Power 21 and that our submarine and mine warfare communities continue to work closely and effectively together.

Rear Adm. Chuck Horne, USN (Ret.)
Former COMINWARCOM 1979-1984

Admiral Horne,

Thank you for your interest in UNDERSEA WARFARE Magazine and for your kind words.

In today's modern security environment, "jointness" is essential to the success of our Navy, our armed forces, and those of our allies. Sea Predator is just one of many examples of different warfare communities; not only in the Navy,

but throughout the Department of Defense working together toward a common goal and it is through this cooperation that we can more easily achieve our objectives.

dear EDITOR,

I recall reading that there were two submarines – K-19 and K-219 – that went down in the 1970s and 1980s due to radiation problems. Were there any articles featured in UNDERSEA WARFARE Magazine about either incident?

Thank you!
Allen Gaines

Mr. Gaines,

Thank you for your interest in UNDERSEA WARFARE Magazine. We did, indeed, recently run an article on K-219 ["Loss of a Yankee SSBN" UNDERSEA WARFARE Magazine, Fall 2005]. The article was authored by the former XO of K-219, Captain 1st Rank (Ret.) Igor Kurdin, and former UNDERSEA WARFARE Magazine Military Editor, Lt. Cmdr. Wayne Grasdock.

sailorsFIRST



Photo by Chief Petty Officer David Rush

Master Chief Petty Officer of the Navy (MCPON) Terry Scott speaks to the crew of the Los Angeles-class fast attack submarine USS Key West (SSN-722). Key West had recently returned to her homeport of Naval Station Pearl Harbor from a Western Pacific deployment.



CHINFO Merit Award Winner



Silver Inkwell Award Winner

JOINT SPEC OPS: Air Force, Navy Test Rescue Scenario



Photo by Master Chief Petty Officer (SS) Daniel J. Niclas

A U.S. fighter pilot has been shot down. He is injured and behind enemy lines, but he has established communications and is evading the enemy. Time is a critical factor. He needs to be rescued, and he needs to be rescued *now*.

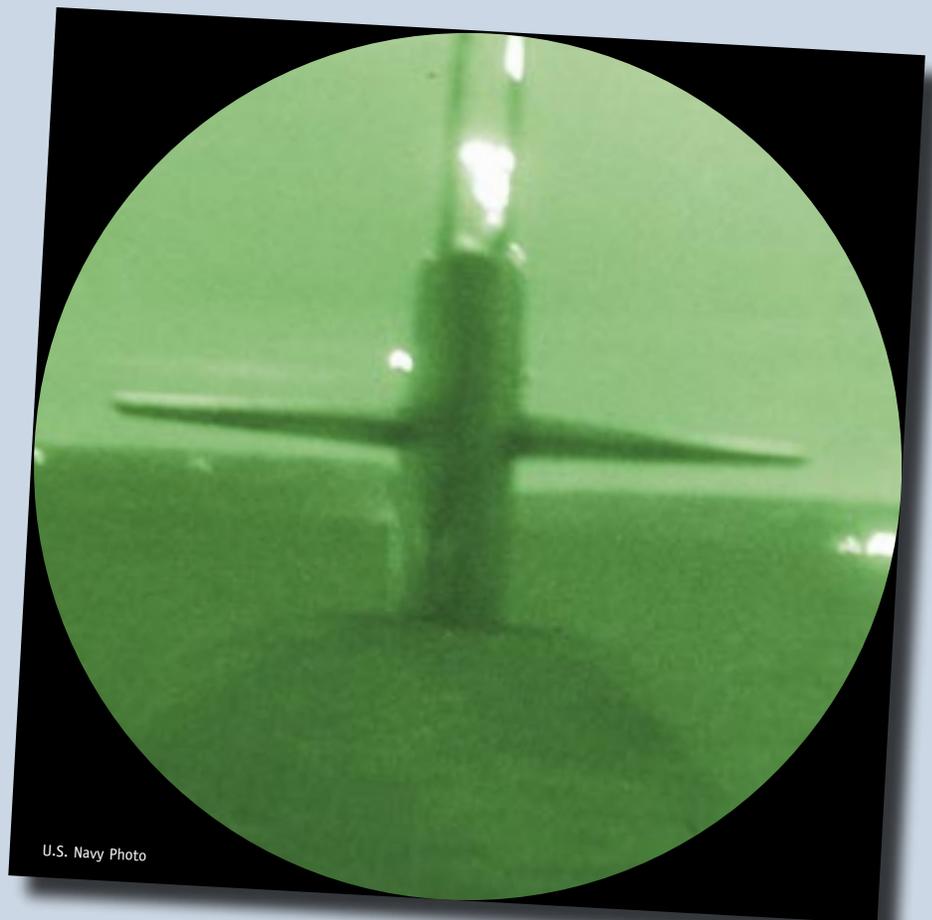
Submerged off the coast, 19,000 tons of stealth in the form of an *Ohio*-class SSGN submarine lies waiting. It's equipped with operational equipment and storage to support over 60 Special Operations Forces (SOF). Notice it reads SOF, not just Navy Special Warfare (SEALs). This is a joint platform that caters to all SOF warriors from all services. And if all else fails, it has over 150 Tomahawk missiles at its disposal that can be precision guided down Main Street and right into Mr. Bad Guy's living room. Talk about surround sound.

A team of operators from an Air Force Special Tactics Squadron (STS) is stationed nearby. They receive word that their unique services are needed. Para-Rescue Jumpers (PJs) are trained emergency medical technician special operators capable of jumping into a combat zone and rescuing personnel from any environment. They'll be joined by their Combat Controller teammates, who jump in with them to control air power at the objective and provide all command, control, and communications for the clandestine team's missions. Together, with their comrades, the Special Operations Weathermen, they form a unique and versatile team within the joint SOF community: the Air Force Special Operations Command's Special Tactics Squadron.

In this particular mission, the STS operators will fly out to meet the submarine aboard a Navy search and recovery helicopter. They'll drop onto the slippery deck by fast-roping from the helicopter. Then, the Airmen will go below with their gear to set up for the rescue mission.

The submarine goes back under the water and moves closer to the shoreline. From there, the STS team will leave the submarine after pulling all their gear, boats, and engines through one of the sub's hatches, inflate their boats, and zoom in to the shore. The plan calls for meeting the downed pilot, treating his injuries, and zooming back out to sea for a complex rendezvous with the sub.

It's scenarios like these that require cooperation among the services. It also



U.S. Navy Photo

(left) Air Force special operations troops prepare to launch an inflatable boat from the deck of USS *Alabama* (SSBN-731).

(right) The sail of *Alabama* as seen through night vision equipment.



Photo by Master Chief Petty Officer (SS) Daniel J. Niclas

requires practice to iron out the wrinkles in the process. That is where USS *Alabama* (SSBN-731) stepped up to provide a practice platform for the Air Force's 22nd and 23rd Special Tactics Squadrons. The Airmen spent November 11-18 aboard the submarine practicing various scenarios in which their services would be required. *Alabama* is an *Ohio*-class Fleet Ballistic Missile Submarine, and served as a surrogate for the SSGN.

The goal of the exercise was to test concepts being worked into the SSGN program, such as the rescue scenario described above. Another test successfully accomplished was the first-ever launch and recovery of a UAV from a submarine, according to Lt. Tyler Johnson, Attack Weapons Systems Officer at Commander, Submarine Squadron NINETEEN. Johnson helped coordinate the exercises between *Alabama* and the Air Force.

"We had four goals for this exercise," said Johnson. "The first was to further define tactics, techniques, and procedures for the SSGN program. Second, we wanted to prove and expand on our joint

interoperability. We also wanted to provide the Air Force with an opportunity to conduct amphibious training with a unique naval resource. Also, we wanted to give the crew of *Alabama* an opportunity to conduct SOF training," he said.

Exercises were conducted day and night, offering different environments to challenge the STS operators and *Alabama's* crew.

"This was a great opportunity for some of our younger troops to train with their joint counterparts and have an impact on the evolving SSGN program," said Lt. Col. Mike Sneider, Commander, 22nd STS, McChord Air Force Base, Wash. "But it was a challenge fast-roping onto the slippery decks and learning to maneuver on the submarine." His teams also gained some appreciation for the submariners' lives onboard their boat. "One of the things we had to figure out was how to get our boats, engines, and gear down the hatches and stowed on the submarine in such a limited space," he noted.

Sneider talked about lessons learned regarding the UAV launch and believes it has a future aboard SSGNs. "The UAV

is definitely another SOF asset that can be launched from this platform. We were able to identify some areas that needed improvement, which was the whole reason we were there – to define areas of process improvement to help make the SSGN the platform it is meant to be," he said. Sneider's teams also benefited from the opportunity to learn from the submariners. "The more we learn and are exposed too, the more effective we'll be in different mission profiles," he added.

Alabama's crew impressed the SOF operators with their professionalism. "It takes a very professional and patient crew to work through the kinks in these brand new tactics with us. Because of their outstanding professionalism, we were able to accomplish more than we had originally set up to do," Sneider said. The extra training tested other capabilities, such as recovering inflatable boats on the submarine, and it saved money by packing more training into the limited amount of time already allotted.

The crew of the submarine enjoyed hosting the STS teams and learned from them

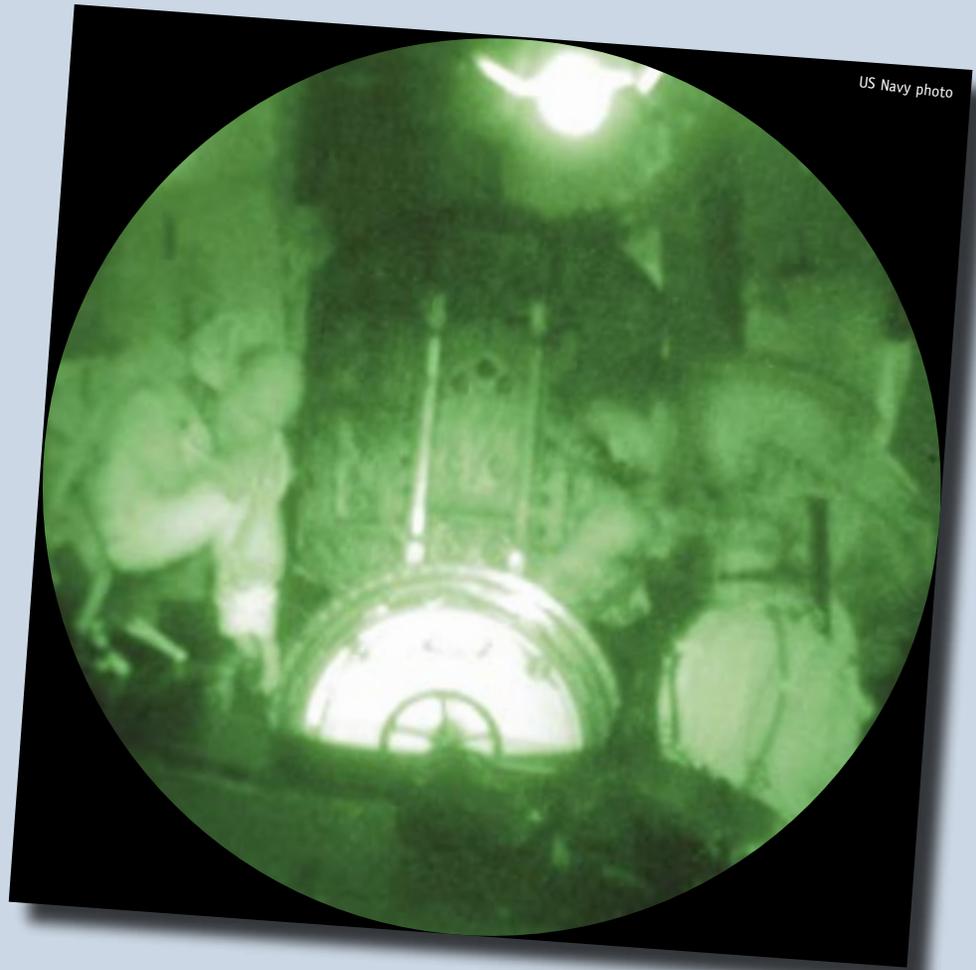
(left) Special operations troops prepare to launch a UAV from the deck of *Alabama*. The UAV can be used to provide security for the submarine or provide reconnaissance for the deploying forces.

as well, according to Lt. Donta Tanner, Supply Officer for the boat.

“They are very professional and a lot of fun to work with. I’m glad we had the chance to participate in this exercise and train with the Air Force,” he said.

The exercise served to demonstrate SSGN capabilities and prove the joint capability of the program. As the Navy moves into more littoral operating areas, the ability to operate jointly with the other services will play a more dominant role in the Navy’s future. This is a future the Air Force looks forward to being a part of, noted Sneider. “Our mission statement since 9/11 is to support the Global War on Terror, and the SSGNs will enable us to train and mix with the other SOF operators to bring air power to the objective from a submarine.”

Petty Officer Howlett serves as the assistant public affairs officer for COMSUBGRU-9.



(above) Air Force SOF remove their gear through *Alabama*'s hatch in preparation for a night exercise.

(left) Air Force special operations troops from the 22nd and 23rd Special Tactics Squadrons fast rope onto the deck of USS *Alabama* (SSBN-731) during a recent exercise to test the capabilities of the SSGN class submarines entering service this year. The SSGN class submarines are being converted from the same hull type as *Alabama*, which played the part of an SSGN during the exercise.

The Art of the Possible

Communications at Speed and Depth

Under the management of the Submarine Integration Program Office (PMW 770), the U.S. Navy has put in place highly-focused connectivity initiatives at the Program Executive Office for C4I and Space in San Diego, California. These efforts are addressing a broad spectrum of technology enablers, including advanced acoustic and acoustic-RF (radio frequency) communications, high-bandwidth satellite communications, and optical-fiber buoys – across all frequency bands (see Table 1) – that promise to achieve long-sought Communications at Speed and Depth (CSD) goals. And while it was in the midst of a comprehensive CSD Analysis of Alternatives (AoA) that was completed in the early fall of 2005, the Submarine Force was also pressing on with technology demonstrations that will underpin the art of the possible.



A future undersea communications network capability will enable communications among submerged submarines, Unmanned Undersea Vehicles (UUVs), and undersea sensors to multiply the effectiveness of the Submarine Force in maintaining undersea dominance. By coupling the undersea acoustic communications network with the mainstream Global Information Grid (GIG) communications infrastructure, end-to-end warfighter connectivity is enabled among surface, air, shore, submarines, other undersea platforms, and undersea sensors.

“The Submarine Communications at Speed and Depth Program extends the principles of FORCENet below the ocean surface to provide the Submarine Fleet with two-way networked connectivity when operating at tactical depth and speed,” Navy Capt. Dean Richter, PMW 770 CSD Acquisition Program Manager, explained. “The goal of CSD is to multiply the effectiveness of submarine platforms in support of Navy, joint, and coalition warfare by enabling two-way communications and network-centric warfare while optimally engaged in the mission at hand. These increased operational capabilities will allow submarine platforms to maintain their stealth posture while supporting Special Operations Forces [SOF] and providing decisive firepower for the Joint Task Force [JTF] in the Global War on Terror [GWOT],” he noted. “Carrier and Expeditionary Strike Groups are provided with significantly enhanced protection against undersea threats with the full utilization of the superior weapons and surveillance capabilities of a submarine operating at depth in coordinated anti-submarine warfare operations to achieve undersea dominance.”

This ultimate outcome was anticipated in the “Submarine Force Future Capability Vision,” which states that “Submarines *must* be a part of the joint and service information networks, to include sensors and networks deployed from the submarine and off-board vehicles. Effective integration into these networks allows the submarine to share situational awareness, plan collaboratively and fight synergistically with other joint forces.” [Emphasis added.] The “Vision” calls out specific FORCENet development goals, including “Connectivity from below periscope depth at tactically useful speeds to reduce time latency in the exchange of information for situational awareness, blue-force tracking, and target engagement.”

There are clearly strategic imperatives for effective CSD, Richter acknowledged. “CSD responds to the following critical operational goals for defense transformation as identified in the *Quadrennial Defense Review Report 2001*, the Secretary of Defense *Transformation Planning Guidance* of April 2003, and the FY 2004-2009 *Defense Planning Guidance*:

- Assuring information systems in the face of attack and conducting effective information operations.
- Projecting and sustaining U.S. forces in distant anti-access or area-denial environments and defeating anti-access and area-denial threats.
- Denying enemies sanctuary by providing persistent surveillance, tracking, and rapid engagement with high-volume precision strike, through a combination of complementary air and ground capabilities, against critical mobile and fixed targets at various ranges and in all weather and terrains.
- Leveraging information technology and innovative concepts to develop an interoperable, joint C4ISR [Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance] architecture and capability that includes a tailorable joint operational picture.

“We are looking to provide significant warfighting advances and two-way FORCENet-centricity at the highest data rates possible at all speeds and depths,” Richter underscored.

Top Priority

“Based on a study by the Undersea FORCEnet Working Group, CSD is one of the Navy’s top three undersea priorities,” Richter added. “And it’s vitally important to ensure that the submarine, with its very capable sensors and weapons, is plugged into Sea Power 21’s strike-group network. Because of this, CSD is the submarine force’s number-one communications priority.”

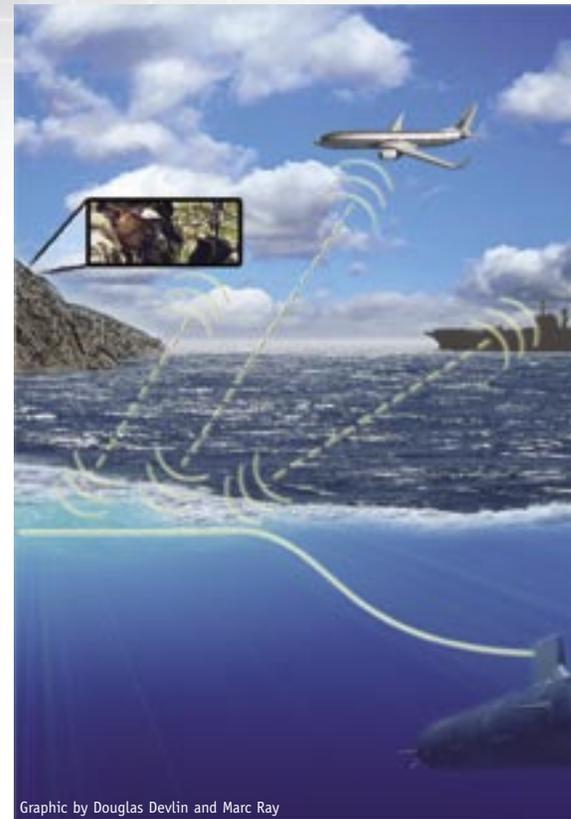
The Navy is funding basic science and technology initiatives within the Office of Naval Research (ONR), as well as research and development efforts with several defense contractors and industry partners, addressing critical technologies that promise to yield significant capability. The Undersea FORCEnet Working Group stood up in March 2003 to help address these needs, with the first CSD Initial Capabilities Document completed that summer and subsequently approved on July 18, 2005. In response to a late-2004 Navy request for ideas, industry and laboratories in the United States and abroad submitted more than 58 near- and far-term technology-focused white papers, which included more than 80 unique concepts. Twenty-two of these were ultimately selected for an Analysis of Alternatives (AoA) that was completed in September 2005. “We’ve found that no single concept or technology meets all of our needs, and thus we are investigating numerous

technologies to generate a ‘family’ of solutions that provide incremental capability to the fleet over time,” Richter said.

These initiatives will follow up on demonstrations already conducted during fiscal year 2005 that focused on modernizing legacy, in-service communications systems, while also addressing new concepts of operations to take advantage of near-term, “low-hanging fruit” improvements. “Even more advanced demonstrations are planned throughout the remainder of 2006,” Richter explained. “We expect to begin fielding near-term solutions as soon as early 2007, providing incremental enhanced capability to the fleet almost on an annual basis.”

Examples of such low-hanging fruit include a simple modification to the existing Buoyant Cable Antenna (BCA), which will allow submarines both to transmit and receive data while operating at modest depths and speeds. Historically, the BCA has been a receive-only system, but off Pearl Harbor in June 2005 the Navy demonstrated a two-way capability that provided internet-based “chat” beyond 50 nautical miles. The objective of an additional test in the Atlantic in August was to demonstrate beyond what was shown in Hawaii, and how new and unusual radios and waveforms can be used with this two-way BCA to extend the range, increase the data rate, and reduce the detectability of

continued on page 32



Graphic by Douglas Devlin and Marc Ray

The Buoyant Cable Antenna with High Frequency antenna and enhanced modem provides two-way voice and robust IP data connectivity from submerged submarines to ship, air, and shore-based warfighters.

Table 1. Communications Frequency Bands

| | | | |
|--------------------------------|------------|------------------------|---------------|
| EHF (Extremely High Frequency) | 30-300 GHz | MF (Medium...) | 300-3,000 kHz |
| SHF (Super High...) | 3-30 GHz | LF (Low...) | 30-300 kHz |
| UHF (Ultra High...) | 0.3-3 GHz | VLF (Very Low...) | 3-30 kHz |
| VHF (Very High...) | 30-300 MHz | ELF (Extremely Low...) | 0.3-3 kHz |
| HF (High...) | 3-30 MHz | | |

Underwater Stealth: Mine Countermeasures' Ace in the Hole

Stealth is a game played superbly by the Air Force's F-117 Nighthawk fighter and B-2 Spirit bomber aircraft in attacking heavily-defended targets. Although these airplanes are not completely invisible to radar at close range, their small detection radii, combined with careful mission planning, allows them to slip through gaps in air defense systems¹. Some years ago, the U.S. Navy also entered the stealth game with the demonstration ship *Sea Shadow*², whose technologies are now being incorporated into the design of the DD(X) destroyer and other surface combatants. Stealth technologies reduce ship susceptibility to detection and tracking by acoustic, hydrodynamic, and electromagnetic field sensors, both above and below water. Underwater stealth is especially important in defeating the threat posed by naval influence mines.

Mines are dangerous. Since 1950, naval mines have inflicted three times the number of ship casualties on the U.S. Fleet than all other threats combined³. During Operation Desert Storm (1991), USS *Tripoli* (LPH-10) was heavily damaged by an Iraqi contact mine, while an Italian magnetic-acoustic influence mine, the MANTA, attacked USS *Princeton* (CG-59)⁴. As recently as Operation Iraqi Freedom (2003), coalition navies were faced with the possibility of a significant naval mine-clearing operation, which was obviated when the weapons were captured before they could be deployed by Iraqi forces⁵.

Mines are cheap and can be easily manufactured or bought on the international

weapons market. They are difficult and time consuming to find and neutralize, and they can be deployed covertly by an adversary without directly confronting the threat of U.S. naval forces. Casualties from a naval minefield can cost the lives of Sailors, delay or alter the outcome of a conflict, prevent rapid reconstitution of naval capabilities, damage local economies, and adversely influence foreign and domestic politics.

Effective U.S. naval mine-clearing capabilities are a major enabler for the "10-30-30" war fighting concept established by Defense Secretary Donald H. Rumsfeld⁶. Under his plan, the services would have 10 days to deploy a major force anywhere in

the world, 30 days to fight and decisively win the war, and then 30 days to be ready to fight again. Neutralizing a minefield sufficiently to allow forcible entry or strike operations in only 10 to 15 days is a major challenge, even with an armada of underwater, surface, and airborne mine countermeasure (MCM) platforms. A ship casualty caused by a single mine that was missed during clearing operations could adversely impact all phases of the "10-30-30" strategy.

The Rules

The mine countermeasures game is complicated. The risk of losing a ship or submarine to a mine is very scenario dependent, and it is sensitive to such parameters as:

- The density of mines in the field (determined by number and spacing)
- The availability of mine hunting and sweeping platforms in theater and their effectiveness in the specific operational environment
- Mission plans and their time constraints
- The required length and width of safe-transit lanes ("Q" routes) and the area needed to conduct operations
- The likelihood of friendly combatants to actuate a mine during their transit through the field
- The vulnerability of friendly vessels to damage from a detonation



U.S. Navy photo

Although the absolute effectiveness of mine-clearing operations and their impact on the overall mission depends heavily on these factors, the general relationship of combatant losses to MCM tactics and technologies has a well-defined character irrespective of scenario details.

Off board MCM systems are very effective in detecting and neutralizing mines moored in the water column, especially in comparison to their performance against bottom mines. In addition, onboard mine hunting sonar equipment is being developed that can quickly and reliably detect moored contact mines with sufficient warning time to allow a naval vessel to avoid them. In contrast, the buried or partially-buried multi-influence bottom mine is a very imposing threat and difficult to defend against.

Naval combatant susceptibility to bottom influence mines has a parabolic dependence on the level of MCM effort expended before the first attempt to transit the field. Figure 1 shows hypothetical examples of this parabolic relationship for dense, medium-dense, and sparse minefields. The horizontal axis represents the amount of MCM effort measured in platform-days, that is, the sum of the number of days each MCM platform (helicopters, unmanned underwater and surface vehicles, etc.) devotes to the clearance operation. Although the absolute scales on the axes of the graph

and the relative vertical separation between the three curves will depend on specific scenarios, the trends shown in the figure apply to any minefield.

The MCM “Game Strategy”

All good defenses are layered, and MCM is no exception. The first and best defense against mines is to prevent their manufacture, transport, and deployment. But because of tactical or political constraints, many of them will slip through and be deployed against U.S. and allied vessels. The second defensive layer includes detecting mines by hunting, destroying them with explosive charges, and decoying them with influence sweeping. However, there is always a chance that one or two will be missed due to mission time constraints, unfavorable environmental conditions, equipment malfunctions, operator error, or poor planning. The final burden of defense then falls on underwater signature stealth, to hide a vessel from attack by a mine or to blind it with a jamming signal.

The MCM effectiveness curves show several important characteristics of mine-clearing operations that can be used to plan a strong defensive strategy. First, the time constraints of the “10-30-30” war-fighting concept will limit the best possible MCM effort to some maximum value. As demonstrated by the vertical line in Figure 1, the risk to combatants would then vary depending on the density of the mines

encountered. The first and best MCM strategy is to prevent mines from being laid, or to keep a sparse minefield from becoming dense by denying enemy forces the opportunity to deploy the weapons.

Losing a ship to a minefield or accepting casualties to its crew is unacceptable. The sinking of a single naval platform or its receiving mission-abort damage could easily extend the conflict beyond the 30 day war-fighting phase of “10-30-30”, and could also delay the second 30 day phase of preparing for the next war. Therefore, a low to very-low risk level is required for transiting combatants. The intersection of the horizontal line in Figure 1 with the asymptotic portion of the effectiveness curves shows that to achieve a low-risk condition could require a significant, or even unachievable, MCM time-line, depending on the mine density. The diminishing returns of the MCM effectiveness curves (flattening at higher levels of MCM effort) are caused by the resource-intensive process of removing the last one or two mines from the field; a characteristic of all mine-clearing scenarios. It takes only one missed \$10,000 mine to sink a \$2 billion ship.

Playing the Ace

Underwater stealth for ships is achieved through the application of signature-reduction technologies. Influence mines actuate on the mechanical or electromagnetic energy generated by a ship or

submarine's hull, machinery, or electrical equipment. Ships and ship systems generate acoustic and seismic signatures, hydrodynamic (pressure) signals, static magnetic and electric fields, and electromagnetic (alternating electric and magnetic) fields. An influence mine's firing logic combines outputs from its sensors to:

- Reduce environmental background noise
- Classify the target
- Localize the target to maximize lethality of the attack
- Identify and reject signals from mine-sweeping systems or other false target sources.

Minimizing a naval vessel's underwater signatures makes each of these four tasks much more difficult for the mine, and sufficient stealth can actually render it ineffective.



The Swedish *Visby*-class corvette is a composite hull (carbon fiber reinforced plastic) combatant that has both above and underwater stealth design features. The design of the *Visby* minimizes the optical and infrared signature, above water acoustic and hydroacoustic signature, underwater electrical potential and magnetic signature, pressure signature, radar cross section, and actively emitted signals.

Like stealth aircraft flying against an air defense system, reducing underwater signatures can shorten an influence mine's actuation radius to the point where it is no longer a threat. For example, water depths deeper than a bottom mine's attack range need not be immediately cleared, along with the buffer zones along the edges of transit lanes and maneuvering areas. In addition, vessels employing underwater stealth technologies would have a reduced probability of actuating any residual mines that might have been left after clearing.

Decreasing the attack radii of deployed influence mines is analogous to reducing the effective density of the field. For example, if 100 mines have been deployed in an area but only 25 can detect the transiting targets due to the latter's low signatures, then the effective density of the field has been reduced by 75 percent. As shown by the parabolic mine-clearing curves in *Figure 2*, underwater signature mitigation can reduce the effective mine density, and improve the efficiency of MCM operations by lowering the time needed to achieve a low risk condition significantly. Eventually, all mines will have to be removed from the field before naval and commercial ships not equipped with stealth technologies can transit the area, but this can be accomplished after the time-constrained forced-entry or strike phase of the operation has been completed.

A second way underwater stealth improves MCM effectiveness is to increase the efficiency of minesweeping. The firing thresholds of mines are typically set so that for actuation, the target needs to be close enough for a detonation to result in a high kill probability. Depending on the scenario, setting the firing threshold too high

— requiring a larger signature — could result in a catastrophic failure of the minefield, allowing all ships to pass safely. But if ship signatures are reduced and the minefield planner does not likewise lower his actuation thresholds, then the firing radius of his mines will be smaller. On the other hand, if the minefield planner decreases the actuation thresholds to maintain the same damage radii with quieter ship signatures, the more sensitive firing criteria will make the mines easier to sweep. In either case the risk to transiting ships is reduced, and can be viewed once again as equivalent to lowering of the mine density curves of *Figure 2*.

An ace in the hole does not guarantee a winning hand, especially if it is played poorly. It has also been suggested that artificially enhancing the amplitude of a vessel's underwater signatures would reduce the threat of influence mines by causing them to detonate while the target is still outside the warhead's damage range. However, the firing logic found in modern multi-influence weapons easily prevents this from occurring. Thus, deliberate signature amplification would raise the effective density of the field by increasing the actuation ranges and threat from those mines that were previously rendered ineffective using underwater stealth techniques, while providing little protection to follow-on traffic (see *Figure 3*). Risking a \$2 billion manned combatant to sweep a minefield instead of a helicopter or unmanned surface vehicle is not a good bet.

Ironically, a submarine, the quintessential stealth naval vessel, cannot use all the mine-clearing tools available to surface ships. To remain undetected, pre-cursor sweeping before transiting a minefield is

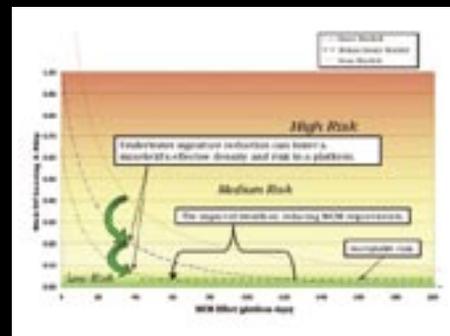
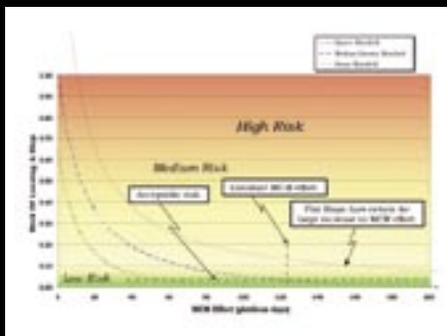
(left to right) Fig. 1 Mine countermeasure effectiveness and the relationship between combatant risk and mine-clearing effort.

Fig. 2 The impact of underwater stealth on mine-clearing effectiveness.

Fig. 3 The impact of deliberate signature amplification on risk of losing a combatant.

Fig. 4 The impact of omitting sweeping from submarine mine-clearing operations.

Fig. 5 Risk of a minefield to a stealth ship.



generally not an option for submarines. Even if unmanned underwater sweep systems were available, their successful use in detonating mines would immediately give away a submarine's approximate location or reveal its intended lane of transit. A submarine must rely solely on hunting mines, avoiding them, and if necessary, covert – non-explosive – neutralization.

Removing sweeping from the submarine's mine-clearing toolbox raises the minefield's effective density in comparison to an equivalent surface ship scenario. For the reasons discussed, all mines may not be detected during hunting operations. In addition, losing the benefit of pre-cursor sweeping increases the mine hunting timeline necessary to reduce the submarine's risk to an acceptable level. Therefore, more mines will remain in the field – yielding a higher effective density – for a submarine, hunting-only scenario than in the equivalent case for surface ships that includes sweeping (Figure 4). As a result, a submarine requires more underwater stealth and higher levels of signature reduction than a surface ship to survive similar types of minefields.

Stacking the Deck

Unlike poker, warfare is not a game that needs to be played fairly. The lives of Sailors and the wellbeing of the nation are at stake. Overwhelming military force must be used to win conflicts quickly and within the clearly defined "10-30-30" time constraints. Underwater stealth can enable combatants to achieve surprise and conduct their strike-warfare missions quickly and with low risk of mine damage, even with minimal MCM efforts.

New signature reduction technologies could make naval combatants as invulnerable

to mine threats as the F-117 fighter and B-2 bomber are to air defenses. However, as with aircraft, achieving stealth must be a primary design objective from the very beginning, because incorporating the means to quiet underwater signatures cannot be an afterthought while building ships and submarines.

All aspects of mechanical and electrical ship systems must be considered in designing a vessel with quiet underwater signatures. These include hull shape and internal structure, material properties, propulsion and auxiliary machinery, electrical systems, payloads, sensors, and active signature-compensation systems. A true stealth ship would have a very small mine risk curve similar to that shown in Figure 5. Like its more familiar aircraft counterparts, the stealth ship may not be completely invisible to influence mines at extremely close ranges; but combined with careful mission planning, it could slip in and out of minefields with near impunity.

The design and construction of a strike-capable "Underwater Stealth Ship" would benefit U.S. naval warfare in several ways. First, a squadron of these combatants could be used against objectives that are heavily defended by mines with the same military advantages realized by stealth aircraft against robust air defenses. Second, all the aspects of a vessel's structure, systems, and individual components that contribute to its underwater signatures would be identified, their relative importance quantified, and silencing methods developed. Simple and inexpensive changes to designs could be immediately incorporated into new construction. Also, the development of new technologies to provide revolutionary, low signature levels would be accelerated

U.S. Navy Photo



The *Sea Shadow* program began in the mid-1980s. Its purpose is to explore a variety of new technologies for surface ships, including ship control, structures, automation for reduced manning, sea-keeping and signature control.

in the process. Incorporation of these new technologies into the design of all future naval vessels could then concentrate on reducing system costs and ship impact. The force-multiplying payoffs and the technology development process of the F-117 and B-2 aircraft exemplify the right way to play the game of underwater stealth.

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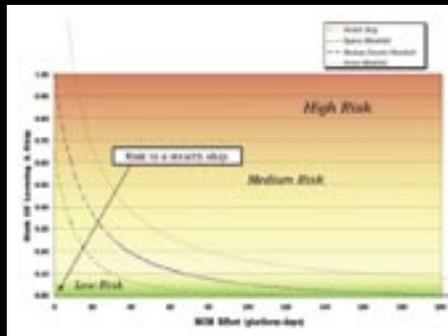
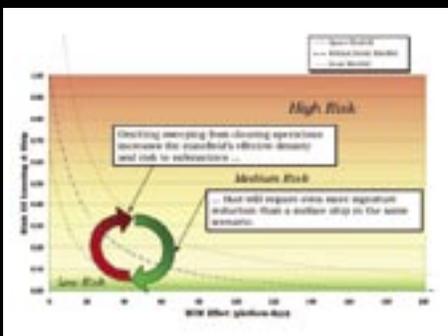
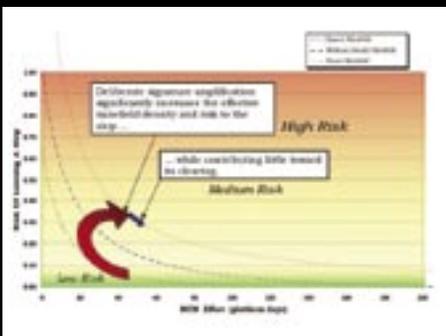




Photo by Ray S. Narimatsu

USS *Ohio*, 1st Guided-Missile Plat

(above) Sailors assigned to the guided-missile submarine USS *Ohio* (SSGN-726) man the rails for the boat's return to active service ceremony held on board Naval Base Kitsap Bangor.

(below) Vice Chairman of the Joint Chiefs of Staff, Adm. Edmund Giambastiani, Jr., talks about the importance of the guided missile submarine (SSGN) program at the return to service ceremony for *Ohio*.



Photo by Ray S. Narimatsu

The first of four *Ohio*-class TRIDENT missile submarines being converted to carry guided missiles and Special Operations Forces (SOF) rejoined the fleet in a return to service ceremony at Naval Base Kitsap-Bangor Feb. 7, 2006.

In December, USS *Ohio* (SSGN-726) completed conversion to a guided-missile submarine capable of carrying more than 150 Tomahawk cruise missiles and more than 60 SOF members for extended periods. This conversion is a major step forward in the Navy's ability to fight the Global War on Terror.

During the ceremony, guest speaker Adm. Edmund P. Giambastiani, vice chairman, Joint Chiefs of Staff, spoke of the new role *Ohio* will have as it steers towards danger, rather than away from it:

“As it became clear our deterrence goals had been met, our Congress authorized the conversion of these four boats to support SOF strikes. This platform has truly been a case study in transforming our military capabilities to meet the future needs of our joint forces. In doing so, *Ohio* has proven our concepts are validated as the SSGN prepares for our uncertain future by being on station and providing a forward deployed presence, adaptability and modularity that are exactly the kind of capabilities our Quadrennial Defense Review calls for.”

“*Ohio*’s return to service is truly monumental. In the span of a little more than three years, we have taken a proven weapon system and completely changed its operating paradigm,” said Rear Adm. William H. Hilarides, Program Executive Officer (Submarines). “Now *Ohio* will conduct missions that will have a direct

impact on the on-going Global War on Terror and, because of its payload capacity, *Ohio* and the other three SSGNs will free up Navy assets in the near future. SSGNs are truly force multipliers.”

Instead of 24 TRIDENT C-4 Submarine Launched Ballistic Missiles, *Ohio* and the other three SSGNs – USS *Michigan* (SSGN-727), USS *Florida* (SSGN-728), and USS *Georgia* (SSGN-729) – can carry 154 Tomahawk land-attack cruise missiles and 66 Special Operations Forces (SOF) for extended periods of time.

Two of the SSGN’s missile tubes are dedicated lock-in/lock-out chambers which will allow combat swimmers to leave the submarines while submerged. To further support SOF, the ships will accommodate up to two Dry Deck Shelters, two Advanced SEAL Delivery Systems, or one of each atop the lock-in/lock-out chambers. The remaining 22 tubes will each be



Photo by Chief Petty Officer (SW/AW) Dave Fliesen

(above) Petty Officer 3rd Class (SS) Zachary Foran (left) stands the Helmsman watch while Chief Petty Officer (SS) Richard Gregor gives him orders as he supervises the helm and stern planes aboard *Ohio* prior to her return to service ceremony.

(bottom left) Petty Officer 2nd Class (SS) Michele Angel mans a Tactical Tomahawk Weapons Control System (TTWCS) console in the Attack Weapons System aboard *Ohio* prior to her return to service ceremony.

form, Rejoins Fleet



Photo by Chief Petty Officer (SW/AW) Dave Fliesen

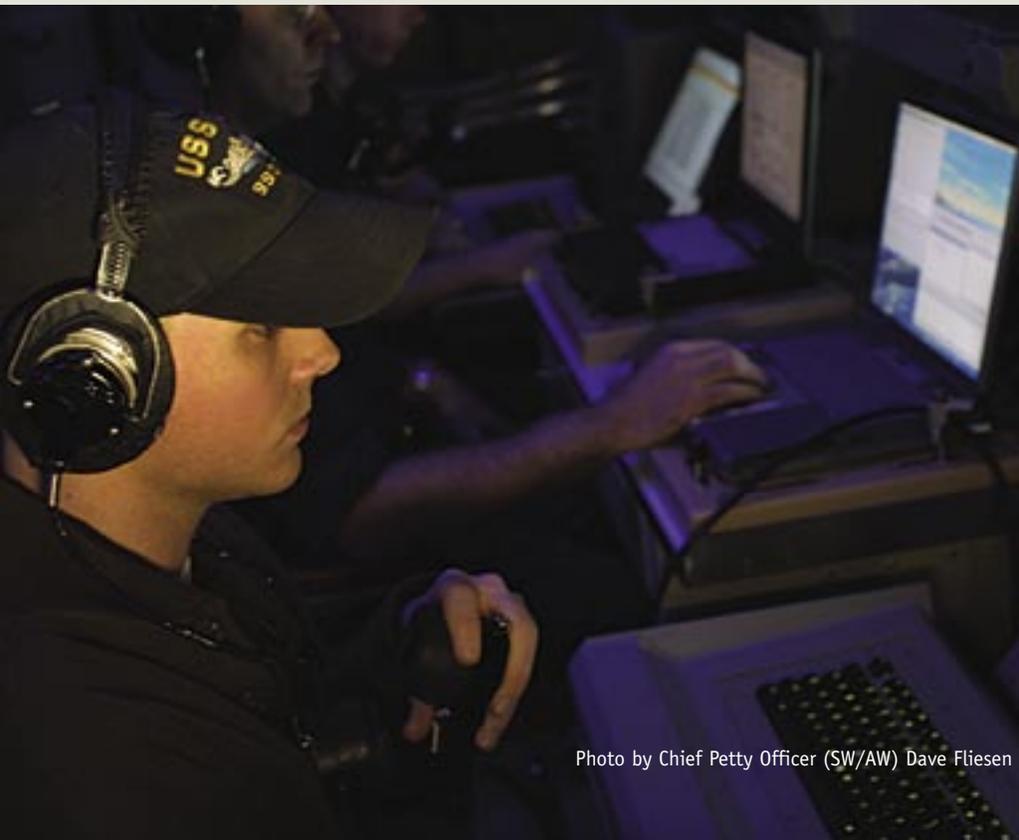


Photo by Chief Petty Officer (SW/AW) Dave Fliesen

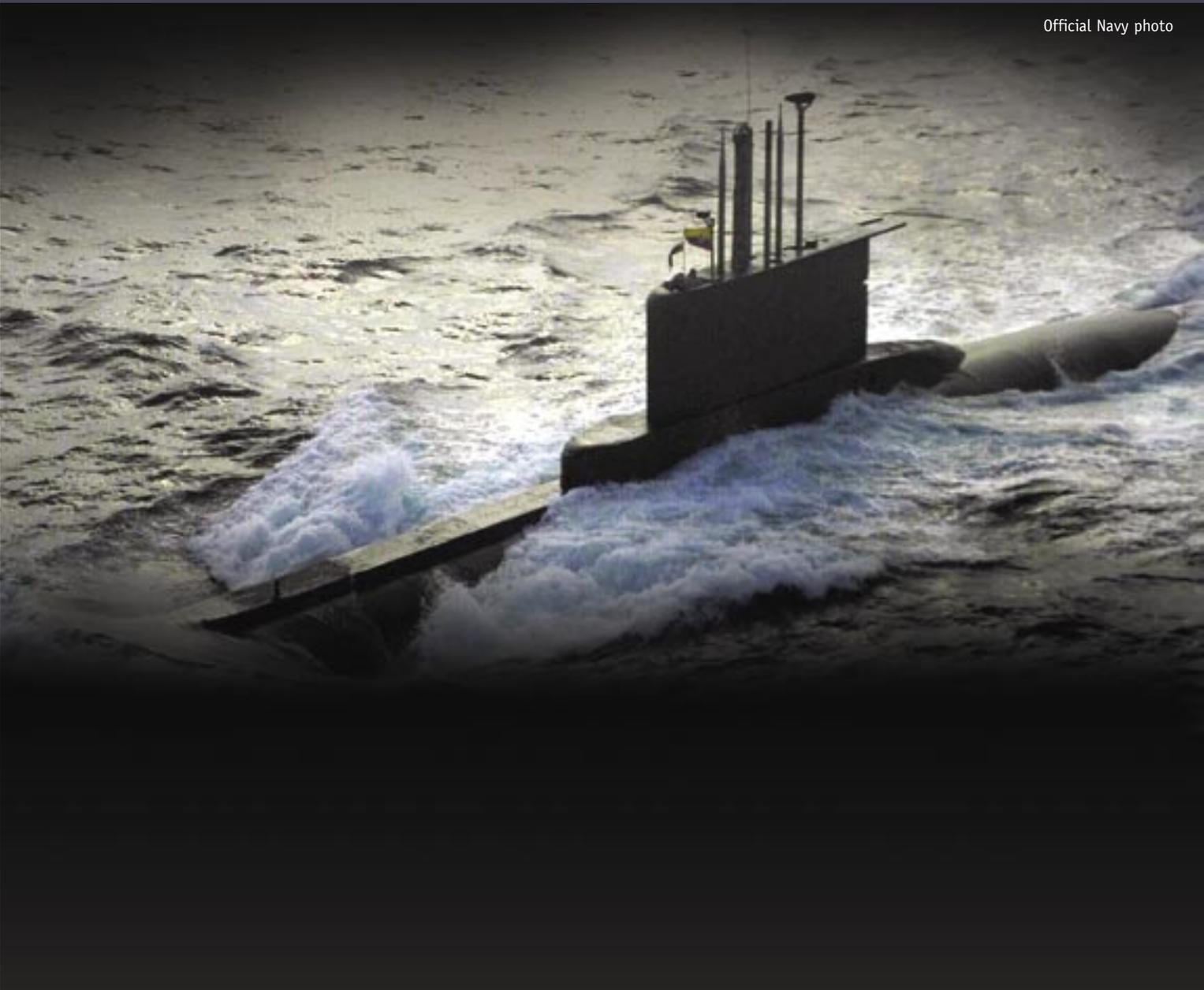
able to hold up to seven Tomahawk missiles or specially designed stowage containers for SOF equipment.

The SSGNs will also play an integral role in joint operations. With two High Data-Rate Antennas, improved Intelligence, Surveillance, and Reconnaissance capabilities, and the new Common Submarine Radio Room, SSGNs will be able to host a Joint Task Force command element

Annie Glenn, the ship’s sponsor, presented the crew with a ship’s patch worn by Sen. John Glenn on his return to space in 1998. The patch was autographed by all seven astronauts aboard the shuttle and will now be displayed in the wardroom.

Michigan, *Florida*, and *Georgia* are scheduled to return to service over the next two years.

Petty Officer 1st Class Howlett is the assistant public affairs officer for COMSUBGRU-9 in Bangor, Wash.



DESI: Diesel Electric Submarine Initiative

A Partnership for Global Security

Deep below the ocean's depths, a game of cat and mouse is played...a hunt with players waiting silently for one another to make the first move...and hear the first sound. It's a battle of metal and might between nuclear-powered and diesel-electric submarines.

With dim green illumination, sonar technicians study acoustic signatures in search of the latest threat...watching, listening, waiting...as the submarine quietly approaches...closing to within firing range.

While these might sound like underwater adversaries, they're actually allies working together to train and test undersea warfare capabilities. Their partnership through the Diesel Electric Submarine Initiative (DESI) provides each country with opportunities to train their crews and test capabilities while helping their partner nations do the same.

"DESI provides training opportunities against the real world threat – a modern, quiet, diesel-electric submarine," said Juan Fernandez, tactical analysis director and DESI Program Manager for Commander Naval Submarine Forces. "Through annual bilateral deployments to each coast, foreign diesel-electric submarines help us attain our fleet ASW exercise objectives. And we share with the participating nations post-exercise results, reconstruction analysis, and lessons learned. That helps them better assess their capabilities and training readiness. It's a great fleet-training support program with excellent return on investment, while fostering theater-wide naval interoperability."

The Colombian submarine ARC *Pijao* (S-28) navigates on the surface off the coast of Mayport, Fla., while participating in anti-submarine warfare proficiency events with helicopters from several Helicopter Anti-Submarine (Light) squadrons stationed at Naval Station Mayport.

"We don't have enough of our own subs to train these battle groups. Working with submarines from other countries helps us fill a void for ASW training," said Rick Current, deputy director for training, tactical weapons and tactical development for Commander Naval Submarine Forces. "Each country's participation in this program is a contribution to the coalition effort."

The DESI program has predominately concentrated on partnerships with South American countries operating submarines. These conventional boats comprise nearly 15 percent of the 224 submarines operated in the free world today by 27 different countries. Established in 2001, the program has engaged several navies operating conventional diesel-electric submarines (SSKs) to provide a series of U.S.-sponsored deployments to support fleet training exercises and tactical development events. The program enters its fifth year with active participation from Colombia, Peru, and Chile. DESI expansion efforts are currently underway to include Canada, Brazil, Argentina, Ecuador, and possibly Norway and Germany. Over the past five years, the DESI SSKs have provided over 450 engagement days to the fleet on both the east and west coasts. In a related program, the year-long bilateral training effort between the U.S Navy's ASW forces and the Swedish attack submarine HMS *Gotland* in San Diego provided about 160 training days to the Pacific Fleet. The DESI program is primarily engaged in providing Carrier Strike Group (CSG) and Expeditionary Strike Group (ESG) ASW training.

As a participating nation's naval capabilities improve, they will also be able to contribute more effectively as Allied forces.

In the past, battle group training was done in preparation for upcoming deployments by pitting groups of U.S. ships against each other in a series of simulations. That approach provided opportunities for commanders to practice tactics in a variety of combat scenarios. In the post-Cold War environment, however, today's threat is more likely to come from a modern, quiet



Vice Adm. Chuck Munns (right), COMNAVSUBFOR, shakes hands with Peruvian Navy Lt. Cmdr. Jose Novoa (left), Executive Officer of the Peruvian submarine BAP *Antofagasta* (SS-32). Vice Adm. Munns personally greeted Otoya and his crew upon return to the port of Callao Naval Base in Peru after a successful deployment to the east coast of the United States in support of various U.S. Atlantic Fleet antisubmarine warfare training events. During the visit, the Peruvian Submarine Force also celebrated its 94th anniversary.



Crewmembers of the Peruvian submarine BAP *Antofagasta* (SS-32) participate in the submarine fire fighting trainer at the Submarine Learning Facility in Norfolk, Va.

diesel-electric submarine. And since the U.S. Navy hasn't operated diesel submarines for over 30 years, it's beneficial to work with partner nations operating diesel submarines to obtain realistic opposing forces for training. Moreover, this alternative better prepares each of the participating navies for operations anywhere in the world.

Diesel-electric submarines are prevalent in many third world countries, and what they lack in firepower, speed, and endurance, they make up for in quiet and stealth. They transit quietly at low speeds, can run on diesels at periscope depth, and are capable of running exclusively on battery power for eight to 24 hours (depending on speed and other factors).

Building Relationships Across The Seas

"This provides a realistic tactical environment which validates undersea warfare training and certifications attained during and after unit-level training," said Lt. Cmdr. Rick Hughes from Commander, Destroyer Squadron TWO FOUR.

Diesel submarines have proven to be difficult sub-surface targets to track., and due to their world-wide proliferation, they are a tactical challenge that cannot be dismissed. "We were able to employ all of our tactics and give each officer the much needed training against highly capable ASW platforms," stated Capitan de Fragata Jimmy Yusti Robles, Commanding Officer of the Colombian submarine ARC *Pijao* (S-28). Yusti was involved in several exercises in support of U.S. strike group training initiatives in 2005.

"It's a great idea to have them participate," said Lt. Cmdr. Robert Hudson, Executive Officer of USS *Springfield* (SSN-761). "Our crew had the chance to identify them while they were surfaced, submerged, recharging batteries, and even try to track them while they were in stealth mode. It is good to work with them and to realize what capable platforms diesels can be."

The exercises were equally beneficial for the Peruvian submarine BAP *Antofagasta's* (SS-32) crew. The submarine and crew experimented with various engagement tactics, tested their torpedo firing systems, and worked on close encounter operations. "Some of the tactics worked, but we learned some new aspects, and the training highlighted exactly the type of things we hoped to learn," said Capitan de Fragata James S. Thornberry, Commanding Officer of *Antofagasta* during the first Peruvian submarine DESI deployment (circa 2002). "This is a very good opportunity for us to train in anti-surface and anti-submarine tactics. It is also an opportunity to train in large battle group situations with a high level of realism. These exercises are more advanced and more real than other maneuvers we've been involved in, and we hope to continue these types of operations in future years. We are gaining a lot of knowledge. This exercise has been carried out at a high level of proficiency and we want to achieve that level."

"These newly-forged relationships are bearing success at a very rapid pace," said Vice Adm. Chuck Munns, Commander Naval Submarine Forces. "They're providing

mutually beneficial fleet ASW training and operational readiness while supporting theater and regional security cooperation and interoperability goals." And that demonstration of international submarine force cooperation and interoperability ties into an even bigger issue.

The Thousand-Ship International Navy

"I'm after that proverbial thousand-ship Navy," said the U.S. Chief of Naval Operations, Adm. Mike Mullen, in an August 2005 speech at the Naval War College. "A fleet-in-being, if you will, composed of ships from all freedom-loving nations, standing watch over the seas, standing watch over each other."

Adm. Mullen's concept of an "International Navy" builds on existing partnerships, like DESI, to extend the global reach of sea power with the ability to "share and unite" nations. The U.S. Submarine Force is a member of an international community of submarine-operating nations from 27 countries. Together, these nations help each other improve undersea warfare capabilities while ensuring safety of the seas.

"We conduct bi- and multi-national exercises with 17 submarine-operating nations, and have three countries participating in DESI providing valuable ASW training services to our Fleet," said Vice Adm. Munns. "Additionally, we conduct submarine-to-submarine flag-officer level staff talks with our Allied partners to further improve and enhance cooperation and sharing of operational tactics and lessons learned."

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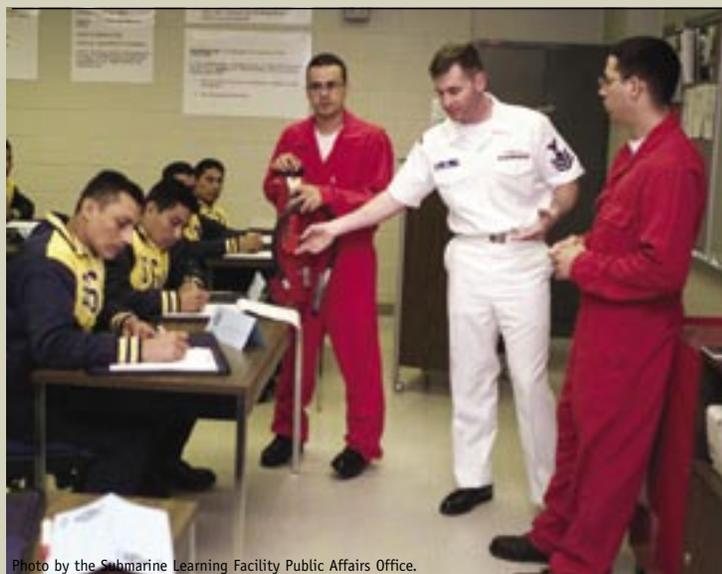


Photo by the Submarine Learning Facility Public Affairs Office.

Instructors from the Submarine Learning Facility in Norfolk, Va., review Submarine Damage Control Trainer safety procedures with crewmembers from the Peruvian submarine BAP *Angamos* (SS-31).

The Naval Oceanography Program

Across the U.S. Navy enterprise, we are in an era of transformation. It is an exciting time that is driven by, and driving, a broad spectrum of factors, from the lightning speed of technological change and the revolutionary impact of the Internet, to an uncertain global political landscape and asymmetric threats to our security. The pace of our transformation continues to accelerate. And by necessity, it will continue to accelerate, conceivably throughout the careers of every Sailor and officer who reads this article.

Nowhere within the Navy is the pace of transformation more evident than within the Naval Oceanography Program. This multi-disciplinary effort provides naval, joint, and coalition warfighters with environmental understanding of the air, surface, and subsurface maritime battlespace to ensure knowledgeable decision-making, to assure safety and readiness for unencumbered global operations, and to enable dominant Sea Power. Supporting all facets of naval warfare, the Naval Oceanography Program is, of necessity, on the leading edge of Navy transformation efforts.



Photo by Chief Warrant Officer 4 Seth Rossman

A prototype of a new atomic clock, currently under development at the U.S. Naval Observatory in Washington, D.C. When completed, this clock will provide more precise positions for weapons targeting, more reliable digital data transfer, and enhanced integrated voice and data capabilities across the Department of Defense.

Photo by Chief Warrant Officer 4 Seth Rossman



The U.S. Naval Observatory, Washington, D.C., serves as the headquarters for the Oceanographer/Navigator of the Navy. Its missions include maintaining a precise time reference and a celestial reference frame for the Department of Defense.



Graphic by the Naval Oceanographic Office

(above) Bathymetric imagery off Panama City, Fla., provided by the Compact Hydrographic Airborne Rapid Total Survey (CHARTS) system. This airborne survey system uses laser imaging to provide rapid surveys of shallow water areas.

(right) Located at the U.S. Naval Observatory in Washington, DC, this historic 26-inch refractor telescope is still used operationally to take precise astrometric measurements of the position and motion of visible stars for celestial navigation. It was with this telescope that the moons of Mars were first discovered in 1877.



Photo by Chief Warrant Officer 4 Seth Rossman

The Naval Oceanography Program is composed of a combination of interwoven capabilities that affect nearly every aspect of Sea Power. Oceanography, meteorology, navigation, hydrography, geospatial information and services, astrometry, precise time, and time interval are all captured within the program. As a result, our Sailors, officers, and civilian employees – our most valuable resource – are critical enablers of every Naval force across all missions from peace to war. Small and nimble, the Naval Oceanography Program has been working to keep a lead angle on Navy transformation efforts to ensure we are always ready to provide the support our operating forces require.

The broad spectrum of mission areas of the modern naval force, the proliferation of quiet, inexpensive diesel-electric submarines around the world, and the strategic importance of shallow water coastal environments (the littorals) combine to require unprecedented environmental awareness for our strategic, operational, and tactical commanders. For example, in the littorals,

Naval Oceanography Program Support to Submarine Navigation

Submarine navigation has a third-dimensional complexity different from surface or air navigation, and has more rigorous requirements. To meet these requirements, the Naval Oceanography Program maps both the ocean bottom and the stars, and provides a precise time reference.

- Hydrographic Surveys: The Naval Oceanographic Office provides high-resolution bathymetric surveys using a variety of assets:
 - A fleet of seven forward deployed USNS *Pathfinder* (T-AGS 60)-class multi-mission ocean survey vessels
 - Small hydrographic survey launches for shallow water and riverine surveys
 - Airborne laser bathymetry systems
 - Sea surface altimetry measurements from environmental satellites
 - Deployable Fleet Survey Teams.

The National Geospatial-Intelligence Agency (NGA) places this data on their Digital Nautical Charts (DNC®) and Tactical Ocean Data (TOD®) charts, both essential to submarine navigation. The quality and precision of the data makes these the most detailed and accurate charts currently available.

- Gravity and Geomagnetism: Oceanographic survey vessels also provide sensitive gravimetric and magnetometric measurements to aid submarine navigation. In addition, geomagnetic surveys provide baseline data for antisubmarine warfare aircraft that use magnetic detectors to find disruptions in the magnetic field made by lurking submarines.
- Precise Time: The U.S. Naval Observatory in Washington, D.C. maintains an atomic time reference for the Department of Defense that is critical to precision targeting, tactical communications, and satellite-based navigation. With an accuracy of one billionth of a second (one nanosecond) per day, the Naval Observatory Master Clock is the most precise operational provider of continuous time service in the world.
- Astrometry: Astrometry is the determination of the precise positions and movement of celestial objects. The Naval Observatory maintains a celestial reference frame of over a billion stars used for positioning all space-based navigation, communication, and weapons systems. These include the Global Positioning System (GPS) constellation and other Department of Defense satellites. The celestial reference frame is also essential for azimuth calibrations of the inertial navigation system used by weapons systems. From their astrometric work, the Naval Observatory also produces the Nautical, Air, and Astronomical Almanacs.

bottom depths and characteristics are continuously changing due to the outflow of riverine sediments, the churning of coastal storms, and surf action on the coastline. Conditions are made more challenging by high ambient noise from coastal industry, high commercial ship traffic, coastal fisheries, recreational boaters, and noisy aquatic life. There are also significant variations in salinity and temperature affecting sound transmission and reception.

All together, the littorals are a challenging environment, characterized by poor acoustics, high reverberation and ambient noise, and treacherous navigation conditions. Through sensing, fusing, and integrating data and providing environmental awareness of the littoral battlespace, the Naval Oceanography Program is determined to provide our commanders with the information, tools, and decision aids needed to continue to succeed.

While remaining aligned to requirements across all mission areas, the Naval Oceanography program is maintaining a robust pace of transformation in all areas. For example, we are changing the way we survey and sense oceanographic, meteorological and hydrographic information, including a greater use of autonomous vehicles. We are improving our environmental models and our ability to predict the future environment of the battlespace. We are working to make better and more effective use of future command, control, communications, computers, and intelligence (C4I) and net-centric warfare tools



Photo by Chief Warrant Officer 4 Seth Rossman

The U.S. Naval Observatory Master Clock, located in Washington, D.C. Achieving an accuracy of one billionth of a second per day, it is the most precise provider of time services in the world.

in support of commanders. And, we are working closely with partners across the Department of Defense, and the inter-agency and international communities to maximize our effectiveness.

The pace of change is great; the challenges are complex, and anything less than complete success is not an option. The Naval Oceanography Program is working hand in hand with the Undersea Enterprise to meet current and future challenges. It is an exciting time to be on the leading edge of the Navy's transformation efforts!

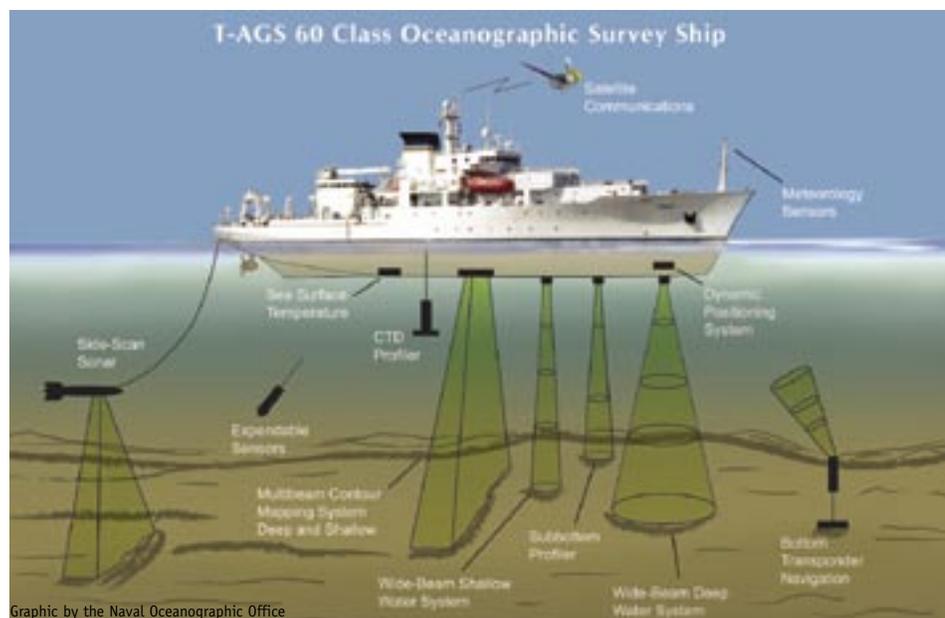
Rear Adm. Byus is currently the Oceanographer and Navigator of the Navy. He has previously served aboard USS *Swordfish* (SSN-579), *New York City* (SSN-696), and *Plunger* (SSN-595); he also commanded USS *Tautog* (SSN-639) from 1993-1995.

Naval Oceanography Program Support to Submarine and Undersea Warfare Operations

Commander Naval Meteorology and Oceanography Command provides tailored environmental characterization to support safe submarine operations and ensure that submarines and other undersea warfare assets have a tactical advantage from a thorough understanding of the operational environment.

- Ocean temperatures and currents: Oceanic data acquired by satellites and various other sources are used to track changes in the location and speed of ocean currents, fronts and eddies, and areas of tactical importance to undersea warfare operations. The Naval Oceanographic Office's supercomputers maintain the most robust operational oceanographic database in the world. Their global temperature database is a useful tool in predicting sonar performance and ranges.
- Surf zone: As submarine mission capabilities expand, so do requirements for environmental awareness products. For example, special warfare team insertions will require more detailed knowledge of surf conditions, rip tides, near-shore currents, beach slope characterization, water temperature and luminosity, lunar illumination, and so forth.
- Bottom characterization: Since mining operations are frequently executed around harbors, approaches, and chokepoints, much of the same information required for the surf zone is required there, with a special emphasis on sediment characteristics in areas where bottom mines might be used. Recent bottom surveys are needed to discern mine-like objects from debris in the sediment.
- Weather forecasts: The Fleet Numerical Meteorology and Oceanography Center in Monterey, Calif. maintains the Navy's global air-ocean coupled computer models, which are used by highly trained forecasters to produce the most accurate marine weather predictions possible.
- Polar ice: Accurate knowledge of the marginal ice zone and pack ice locations is essential for continuing submarine operations in the Arctic. The National Naval Ice Center in Suitland, Md. uses aircraft and imaging satellites to provide high quality, worldwide analyses and forecasts of ice cover, thickness, density, and movement.

Capabilities of the T-AGS 60 Pathfinder-class multi-mission oceanographic survey ship.



Graphic by the Naval Oceanographic Office



Alligator: The Forgotten Torchbearer of the U.S. Submarine Force

With his ship wallowing in a Nor'easter off the coast of Cape Hatteras, North Carolina, J. F. Winchester, the captain of the wooden screw steamer USS *Sumpter*, was faced with a difficult decision – whether to continue on his mission to join the Union attack on Charleston, South Carolina, towing a revolutionary submersible whose likely foundering threatened to sink *Sumpter* herself – or to cut the towline and save his own ship. Shortly after noon on April 2, 1863, he made his decision, and his tow was set adrift, allowing *Sumpter* to fight another day. And with that decision, Winchester sent the U.S. Navy's first submarine – *Alligator* – to its final resting place among thousands of other wrecks in the “Graveyard of the Atlantic” off Cape Hatteras and – unwittingly – removed *Alligator* from the annals of naval history for almost 140 years.

(above) “The Launching – 1 May 1862” by Jim Christley. This original painting by Mr. Christley depicts the first launching of *Alligator* in 1862. Courtesy of the Independence Seaport Museum, Philadelphia, Pa.

The story of the United States' first submarine does not begin with John Holland – commonly regarded as the father of the U.S. Submarine Force – but with an immigrant inventor from France named Brutus de Villeroi. Little is known about the oftentimes eccentric de Villeroi – why he was in the United States, what his profession was, or even what he looked like. (No photograph or painting of him remains today.) However, we do know that de Villeroi had been experimenting with submersible designs in France as far back as 1832 and that in the 1860 U.S. Census, he listed his occupation – correctly or not – as a “natural genius.”

De Villeroi and his submarine first appeared in the United States on the Delaware River in May 1861. On May 18, *The Philadelphia Inquirer* ran a front-page article describing an “infernal machine” that had suddenly appeared in the waters off the Philadelphia Navy Yard. Alarmed, the harbor police, acting upon rumors that the 33-foot, cigar-shaped vessel was intent on sabotage, impounded the mysterious boat.¹ Moreover, unsure of de Villeroi's intentions and loyalty to the Union, the harbor police arrested him and his crew and turned the unusual vessel over to Navy officials for inspection. Philadelphia Navy Yard commandant Capt. Samuel F. DuPont appointed three officers to examine the vessel, question de Villeroi, and report their findings. The three officers chosen by Capt. DuPont were Cmdr. Henry Hoff, an expert in ship design; Cmdr. Charles Steedman, an expert in naval warfare; and Robert Danby, a naval engineer. The panel reported their findings on July 7, 1861 in what was dubbed the Hoff Report.

The Hoff Report stated that de Villeroi's vessel was seaworthy and had shown four important features during their testing. These were the ability to surface and submerge, the capability to remain underwater for a substantial length of time without exposing anything on the surface, provision for a man to leave and return to the vessel while both remained submerged, and an exterior breathing tube connected to the vessel that allowed a diver to survive outside the submarine underwater. Apparently, de Villeroi's submersible was equipped with a diver lockout chamber, originally incorporated for salvage efforts. Confirming these successes, the Hoff

“On May 18, *The Philadelphia Inquirer* ran a front-page article describing an “infernal machine” that had suddenly appeared in the waters off the Philadelphia Navy Yard.”

Report slowly began making the rounds inside the Navy.

During this time, de Villeroi wrote letters to both the Secretary of the Navy, Gideon Welles, and President Abraham Lincoln. Lincoln's letter was forwarded to the Navy Department and Secretary Welles instructed Commodore Joseph Smith, Chief of the Bureau of Yards and Docks, to provide a response. Commodore Smith reported that it was too small to test as a weapon and recommended that a larger version be constructed on a “no-payment-for-failure” basis.

A contract for the construction of the submarine was signed on November 1, 1861 by Secretary Welles and one Martin Thomas – a contractor who acted on behalf of de Villeroi. The contract stipulated that “The party of the first part will construct and deliver to the party of the second part within forty (40) days from the date of this agreement, an Iron Submarine Propeller of the plan of M. de Villeroi, at least fifty-six inches (56”) in width and sixty-six (66”) inches in height and forty-five feet in length, for the sum of fourteen thousand dollars to be paid when completed and delivered, ready for use within ten days after delivery and certificate is in all respects ready for service.”

Essentially, the Navy and de Villeroi had entered into a contract with a seemingly impossible schedule. De Villeroi was to deliver a submarine to the Navy a mere 40 days after the contract was signed.

Construction began without incident soon thereafter, and by December 7, de Villeroi reported – via letter – to Commodore Smith that the submarine was nearly completed. De Villeroi went on, however, to explain that the construction timeline would likely need to be extended, because parts of the interior were not yet complete. He attempted to justify the delay by stating that the contractor,

Thomas, had not scheduled the construction properly and that the project was unlike any the shipyard had ever pursued before. Unfortunately, excuses were not what Commodore Smith wanted to hear as he grew increasingly frustrated with de Villeroi.

To mediate the growing dispute between de Villeroi and Thomas, William Hirst, a Philadelphia lawyer, was called in. Hirst helped to negotiate a 15-day extension beginning on December 10th. Even so, the situation began to spiral downward. Commodore Smith stood his ground on the delivery date and with good reason: Norfolk had fallen to the Confederates and the iron-clad CSS *Virginia* was finished and ready to enter service against the Union's blockading force. In several heated exchanges, Smith and de Villeroi bickered over the root cause of the problems: the lack of funds to work nights and weekends, the need for a larger construction crew, and more importantly, the contractor Thomas himself. De Villeroi ended his letter by requesting direct contact with Smith, and not through the contractor, so that they might more quickly and easily resolve remaining differences.

This request made an already angry Smith even more irate. In a letter dated January 3, 1862, Smith explained to de Villeroi that he could have no direct contact with him and that all correspondence must go through the contractor. Smith went on to explain that the government could only deal directly with the contractor himself, which was – and is still – standard procedure in most procurement matters.

The extension granted to de Villeroi in December 1861 came and went without the boat being delivered. De Villeroi blamed the delay on not having specific materials needed to produce certain “secrets” mentioned in the original contract and now in the possession of lawyer Hirst.

Although it is not entirely clear what these “secrets” were, they most likely included an air purification system, which would increase the amount of time the submarine could stay submerged, and a battery system to detonate mines remotely.

In a letter written to Smith on January 18th, de Villeroi stated that that once he received the lead and platina – a platinum alloy – he needed, the submarine would be completed. He further stated that because the original delivery date and extensions had passed, Thomas’ services would no longer be necessary and that he and Smith could finally work together directly. Four

days later on January 22nd, de Villeroi received Smith’s reply. Smith declared that de Villeroi would receive no more funding for the submarine until it was delivered and tested, and he continued to stress the importance of retaining the contractor. Commodore Smith then wrote Thomas directly to note that if the submarine was not finished in three or four days and ready to be shipped on the soon-to-depart USS *Rhode Island*, the submarine would no longer be useful to the Navy, because CSS *Virginia* – the ironclad the submarine was designed to counter – was out of dry dock and entering sea trials in Norfolk.

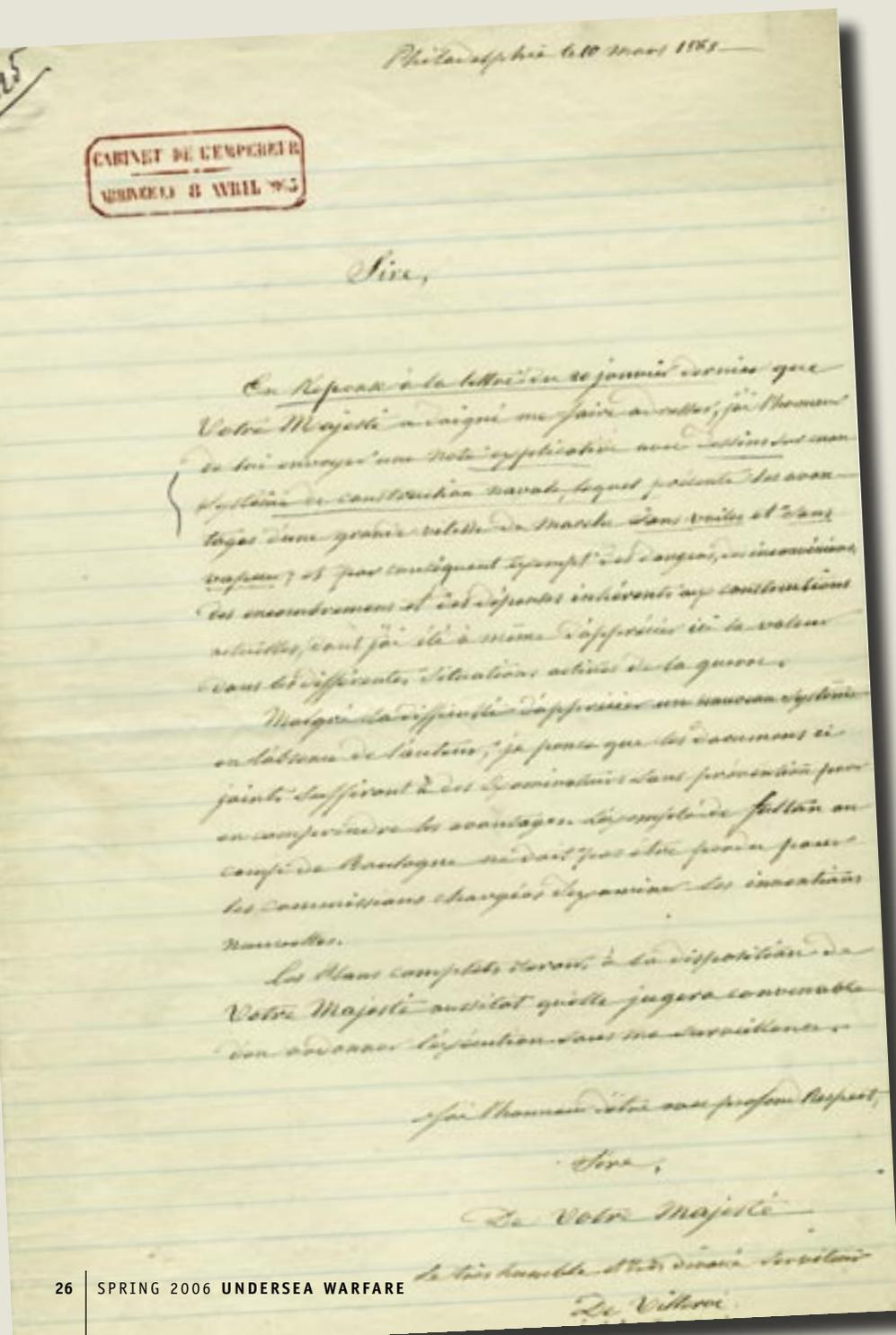
On January 29th, the submarine was reported ready for launching. However, according to a report from Thomas, the launch had to be delayed due to problems with the oars. A contradictory letter sent by de Villeroi stated that the delay resulted from ice on the river. During the interim, the submarine was painted dark green on the outside – a factor that would later contribute to *Alligator’s* name – and white inside.

Two days later – faced by the imminence of the *Virginia* threat – Smith sent yet another letter to de Villeroi stating that although the submarine would no longer be useful to the war effort, the time and effort put into producing the boat made it worthwhile at least to put it through its paces in sea trials. In his letter, Commodore Smith also made a seemingly innocuous statement that markedly improved de Villeroi’s legal position: He told de Villeroi that the contractor was to provide everything needed to finish the project. This essentially gave de Villeroi an “out,” and he immediately responded with a veritable laundry list of items needed to complete construction – including explosives, hydraulic jacks, platina, a telescope, and a chest of tools. He also complained bitterly about Thomas, noting “unethical” discussions the latter had held with scientists, spending insufficient money to maintain the schedule, and the overall expense of the project, which de Villeroi claimed was far less than the award value of the original \$14,000 contract.

While de Villeroi’s letter was on its way to Commodore Smith, the commodore informed Thomas formally that the contract was in default, and thus that the submarine would not be received by the Navy until “further opportunities avail themselves” – at which time the agreement would be renegotiated. When de Villeroi learned of this development, he immediately sent another letter to Smith saying that as he was still an employee of the government and therefore entitled to pay

Brutus de Villeroi sent this cover letter to the Emperor of France, Napoleon III, to sell his proposal for a new and improved design for an oar-powered submarine. This cover letter accompanied the enclosure that described a new 125-foot long submarine that was far more ambitious than *Alligator*.

Courtesy of NOAA



until such time as the Navy revoked his nomination as engineer of the project.

Continuing this seemingly endless string of letters, Smith then wrote de Villeroi explaining their unique situation and that the contract was forfeited because the delivery date had not been met. Smith closed his letter by stating that the project would be stopped and would remain so until de Villeroi and Thomas came to terms and delivered a boat and crew for testing. This letter caused an uproar, sending Hirst into a furious – but ultimately fruitless – letter-writing campaign to mediate the differences between Thomas and de Villeroi, while de Villeroi himself went into seclusion. In a last ditch attempt to salvage the work and his own pride, he wrote directly to President Lincoln, requesting that he be made “commander of the Propeller.” Not surprisingly, the Frenchman never received a response.

On April 18, 1862, Commodore Smith was informed that the U.S. Navy’s first submarine was finally ready. However, it took almost another two months before the Navy and Mr. Samuel Eakin – the submarine’s first commander – took delivery of the boat on June 13th. She emerged as a truly unique vessel with a length of 47’, a beam of 4’8”, and a height of 5’6”. The original propulsion system – oars – required 22 sailors, but later, when she was retrofitted with a screw propeller, this number dropped to eight. The boat was equipped with an innovative air

The Hunt for the *Alligator*

In 2002, the National Oceanic and Atmospheric Administration (NOAA) and the Office of Naval Research (ONR) began the search for *Alligator* in a joint project that has been dubbed “The Hunt for the *Alligator*”.

The following outlines some of the important milestones in the search for the long-forgotten first U.S. submarine.

- May 2002 – Then-Chief of Naval Research, Rear Adm. Jay Cohen; Daniel Basta, director of NOAA’s National Marine Sanctuary Program; and Dr. Robert Ballard, founder and president of the Institute for Exploration discuss an article on *Alligator* first noticed by Mrs. Cohen, wife of Rear Adm. Cohen.

- June 2002 – Rear Adm. Cohen initiates a historical research project to glean information on *Alligator*.

- July 2002– February 2003 – ONR’s Cmdr. Richard Poole leads an intensive research effort at the Library of Congress, National Archives, and Naval Historical Center. He is assisted by Jim Christley, a former submariner, and Mark Ragan.

- August–September 2004 – ONR and NOAA researchers analyze historical documents, in particular those regarding the weather conditions during the loss of *Alligator*. With this information an oceanographic chart is prepared indicating where the vessel may have sunk.

- February 2003 – Cmdr. Poole and Mr. Christley conduct a two-day historical research trip to Philadelphia. They find information regarding Brutus de Villeroi, *Alligator*’s designer.

- May 2003 – NOAA’s Catherine Marzin obtains original letters and blueprints drafted by de Villeroi from the Service Historique de la Marine in Vincennes, France. The blueprints are the only plans of *Alligator* known to exist.

- October 2003 – ONR and NOAA hold the first-ever symposium on *Alligator* in Groton, Conn.

- August 23–29 2004 – Researchers from ONR, NOAA, and East Carolina University conduct the first ever comprehensive search for *Alligator*. The search took place off Cape Hatteras, N.C. and was conducted from ONR’s YP-679 “Afloat Lab.” Based on sonar and magnetic data collected, several target areas were identified for further exploration.

- September 6–10 2005 – Based on a side-scan survey conducted in the spring of 2005, several target areas were investigated by a team of researchers aboard “Afloat Lab.” The information collected is being processed and analyzed for future explorations.

- September 2005–Present – The hunt continues.



purification system and a diver lockout chamber which allowed for a diver to leave the submarine and clear obstructions or plant mines; both features were part of de Villeroi's innovative original design.

Since *Virginia* had already been scuttled by her crew during the Confederate retreat from Norfolk, the Union submarine's original mission had been overtaken by events. However, it was given the task of clearing obstacles in the James River – to allow Union vessels to sail upriver and aid in the bombardment of Richmond – and destroying a railroad bridge at Petersburg. It was during this time that the submarine rather unceremoniously acquired the name, *Alligator*. From 1861 to 1862, she had been referred to by several other names, including Propeller, Submarine Propeller, and Submarine Boat. However, a newspaper report from the spring of 1862 had called the craft *Alligator* because of its green color and because it propelled itself through the water via two banks of oars; and the name stuck.

After further consideration, both the James River and Petersburg missions were cancelled. Because of the depth of the James and Appomattox rivers – less than seven feet at some points – *Alligator* would have been forced to operate semi-submerged, exposing it to attack from shore and possible capture by the Confederates, a risk no one was willing to take. On June 29, having spent a total of only eight days in a “combat zone” and with no new missions assigned, *Alligator* was transferred – under tow – to the Washington Navy Yard for further testing.

From August through December of 1862, *Alligator* was put through its paces in Washington. These tests resulted in the replacement of the oar propulsion system with a more conventional propeller, which doubled the top speed of *Alligator* from two to four knots. During this time, the

civilian crew was replaced by one furnished by the Navy and command was given to Lt. Thomas Selfridge.

With the beginning of spring in 1863 came a new mission for *Alligator* and her crew: to clear obstacles around Fort Sumter in Charleston harbor and attack the ironclads *CSS Chicora* and *CSS Palmetto State*, which had been positioned by the Confederacy to escort supply ships into Charleston harbor and lift the blockade.

On March 31st, a crewless *Alligator* began her voyage to Charleston and Fort Sumter under tow from – fittingly – USS *Sumpter*.² During the voyage, the weather quickly worsened into a storm unlike any *Sumpter's* commander, J.F. Winchester, had ever seen. On April 2nd, the port towline parted. As a result, the submarine pitched and yawed violently and she began to take on water through broken portholes – recently added during her winter in Washington – and loosened plates in her hull. As *Alligator* continued to take on water and started to sink, she threatened to drag *Sumpter* down with her. The tow ship had no other option but to set *Alligator* adrift with the hope that she might stay afloat long enough to be recovered after the storm. *Alligator* was cut free shortly after noon on April 2nd, and as *Sumpter* steamed away – fighting against the storm – *Alligator* slipped over the horizon, never to be seen again.

The attack on Charleston and the two Confederate ironclads commenced three days later and – without *Alligator* – was a major failure. Three months later, the Confederates launched their own submarine of a design similar to *Alligator*, *CSS H.L. Hunley*, in Mobile, Ala. It would later become the first submersible to sink an enemy warship, when it destroyed USS *Housatonic* at Charleston on February 17, 1864.

While *Alligator* was never commissioned,

she had the distinction of being “the first” in many areas for the U.S. Navy. She was the first submarine ordered and built by the Navy and the first to have a diver lockout chamber, to deploy to a combat zone, to be commanded by a U.S. naval officer, and to undergo an overhaul at a U.S. naval shipyard – just to name a few.

Following the war, the United States concluded that a submarine force was not needed to protect her territorial waters for the foreseeable future. This belief, along with de Villeroi's retreat to private life and subsequent death in 1874, helped to push the idea of establishing a submarine force to the back burner of the Navy's consciousness for another quarter century.

Mr. Smith is the Managing Editor of UNDERSEA WARFARE Magazine and an analyst with Anteon Corporation in Washington, D.C.

Endnotes:

1 This submarine was built by de Villeroi on his own accord for salvage purposes. However, he recognized the potential for military use and took it upon himself to exhibit it for the Navy.

2 There's a curious anomaly in the spelling of “Sumter.” The famous fort in Charleston Harbor has always been spelled Sumter. The ship that towed *Alligator* was really spelled *Sumpter* and may even have been named after the fort (with a misspelling). There were subsequent *Sumters* in the U.S. Navy, but never another *Sumpter*.

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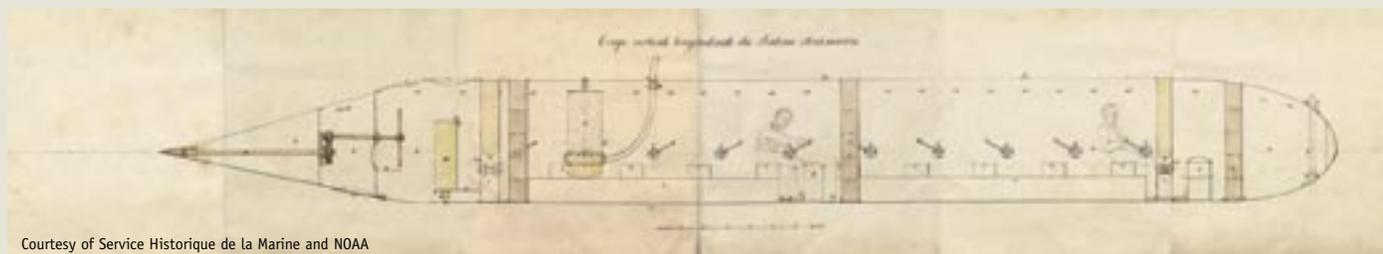
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Courtesy of Service Historique de la Marine and NOAA

(above) This original design sketch by de Villeroi is from his booklet of general plans and is one of few design sketches known to still exist. This sketch illustrates the layout and general size of the submarine.

Pearl Harbor Sub Participates in Undersea Warfare Exercise with ESG

by Petty Officer 2nd Class Corwin Colbert

The nuclear-powered attack submarine USS *Pasadena* (SSN-752) participated in an Undersea Warfare Exercise (USWEX) with the USS *Peleliu* (LHA-5) Expeditionary Strike Group (ESG) 3 near Hawaii Feb. 21-24.

Pasadena Commanding Officer, Cmdr. John Heatherington, said the exercise provided his crew with valuable experience.

"We had the chance to experience realistic submarine combat conditions," said Heatherington. "We were also able to provide and assess crucial submarine warfare training to the ESG, submarine squadron and crew."

USWEX is an exercise that assesses the anti-submarine warfare (ASW) capabilities of a carrier or expeditionary strike group, including the command and control of air, surface, subsurface and theater assets. The *Peleliu* ESG's exercise was planned by the Pearl Harbor-based Commander Antisubmarine Warfare Force Pacific, or CTF 12.

"USWEX is designed to evaluate, at a fleet level, how good we are at ASW," said Lt. Cmdr. Mark Knollmueller, CTF 12's air operations officer.

CTF 12 coordinates with multiple commands to incorporate surface, air and sub-surface assets to provide situational awareness of submarine activity throughout the Pacific.

"For this exercise, CTF 12 did the majority of the planning, such as coordination with many different commands, federal agencies and facilities," said Knollmueller. "It evaluates the Navy's ASW capabilities."

Aboard *Pasadena*, Heatherington said that the Pearl Harbor-based submarine acted as the opposition force for the exercise, helping the *Peleliu* ESG prepare for its upcoming operations in the U.S. 7th Fleet area of responsibility. He also said USWEX is the closest you get to actual battle without firing live rounds.

"Our part was to simulate a real world submarine threat," he said. "We gave the ESG the opportunity to conduct ASW operations as a team."

Knollmueller emphasized that submarines are a serious threat in today's world and it is a high area of concern in the fleet.

"Threats from opposing submarines are lethal. With more and more countries purchasing submarines, we must stay alert, and that is why the fleet and specifically the ESG did this exercise," he said.

In a speech last month to the Asia Society in Washington, Pacific Fleet Commander Adm. Gary Roughead noted that because there are about 140 diesel submarines operating in the Pacific, ASW is his top warfighting priority, and a capability for that requires constant training.

"We, as a Navy, are good at anti-submarine warfare. We can always get better, and that's what we're doing because we have to be able to dominate that growing submarine capability," Roughead said.

ESG 3 includes *Peleliu*, USS *Reuben James* (FFG-57), USS *Port Royal* (CG-73), USS *Gonzales* (DDG-66), USS *Ogden* (LPD-5), USS *Germantown* (LSD-42), and the 11th Marine Expeditionary Unit. The six ships and nearly 6,000 Sailors and Marines departed San Diego Feb. 15 for a six-month deployment.

During pre-deployment training in January, the *Los Angeles*-class fast-attack submarine USS *Asheville* (SSN-758) joined the ESG 3 ships for 13 days off the coast of Southern California. Though *Asheville* is not actually part of the strike group, the exercise helped to prepare the ESG commander to effectively employ a submarine if needed.

Changes of Command

USS *Columbus* (SSN-762)
Cmdr. Charles Marquez relieved
Cmdr. Michael Ryan

USS *Louisiana* (SSBN-743)(B)
Cmdr. Blake L. Converse relieved
Cmdr. John K. McDowell

USS *Key West* (SSN-722)
Cmdr. Thomas E. Ishee will relieve
Capt. Kenneth R. Sault

Qualified for Command

Lt. Cmdr. Sean Fujimoto
USS *Louisville* (SSN-724)

Lt. Cmdr. Christopher Harrington
USS *Nevada* (SSBN-733)(G)

Lt. Cmdr. Steven Mathews
SUBRON-8

Lt. Cmdr. Sean Muth
SUBDEVRON-12

Lt. Cmdr. Patrick Olsen
USS *Key West* (SSN-722)

Lt. Cmdr. Adam Palmer
USS *Albuquerque* (SSN-706)

Lt. Cmdr. Matthew Phelps
USS *Minneapolis-St. Paul* (SSN-708)

Lt. Cmdr. Edward Robledo
USS *Maryland* (SSBN-738)(B)

Lt. Cmdr. Jason Schneider
SUBRON-2

Lt. Corey Thompson
USS *Maryland* (SSBN-738)(B)

Lt. William Wertz
SUBRON-4

Line Officers Qualified in Submarines

Lt. David Campbell
USS *Augusta* (SSN-710)

Lt. j.g. Brian Bernard
USS *Albany* (SSN-753)

Lt. j.g. Andrew Carter
USS *Philadelphia* (SSN-690)

Lt. j.g. Robert Chedester
USS *Augusta* (SSN-710)

Lt. j.g. Brian Datko
USS *Providence* (SSN-719)

Lt. j.g. Paul Easton
USS *Montpelier* (SSN-765)

Lt. j.g. Michael Eliason
USS *Los Angeles* (SSN-688)

Lt. j.g. Matthew Endress
USS *Minneapolis-St. Paul* (SSN-708)

Lt. j.g. Joseph Fackrell
USS Bremerton (SSN-698)

Lt. j.g. Peter Gaal
USS Philadelphia (SSN-690)

Lt. j.g. Jonathan Gandy
USS Honolulu (SSN-718)

Lt. j.g. Preston Gilmore
USS West Virginia (SSBN-736)(G)

Lt. j.g. Ronald Gramlich
USS Alaska (SSBN-732)(B)

Lt. j.g. Christian Heiss
USS Annapolis (SSN-760)

Lt. j.g. Christopher Henson
USS Salt Lake City (SSN-716)

Lt. j.g. Joshua Henri
USS Oklahoma City (SSN-723)

Lt. j.g. Andrew Hoversten
USS West Virginia (SSBN-736)(G)

Lt. j.g. Bryan Hudock
USS Hartford (SSN-768)

Lt. j.g. Aaron Kakiel
USS Hartford (SSN-768)

Lt. j.g. John Kerchner
USS Hampton (SSN-767)

Lt. j.g. Jonathan King
USS Annapolis (SSN-760)

Lt. j.g. Michael Lopresti
USS Jimmy Carter (SSN-23)

Lt. j.g. Ryan Martin
USS Jimmy Carter (SSN-23)

Lt. j.g. Matthew McCue
USS Augusta (SSN-710)

Lt. j.g. Christopher Mendoza
USS Montpelier (SSN-765)

Lt. j.g. David Mensing
USS Albany (SSN-753)

Lt. j.g. Peter Nehl
USS Dallas (SSN-700)

Lt. j.g. Matthew Opfer
USS Tennessee (SSBN-734)(G)

Lt. j.g. Dong Park
USS Minneapolis-St. Paul (SSN-708)

Lt. j.g. Matthew Pelar
USS Jimmy Carter (SSN-23)

Lt. j.g. Reginald Preston
USS Helena (SSN-725)

Lt. j.g. James Prosek
USS Los Angeles (SSN-688)

Lt. j.g. Michael Railey
USS Norfolk (SSN-714)

Lt. j.g. Brian Rhoades
USS Seawolf (SSN-21)

Lt. j.g. Randy Rogers
USS Oklahoma City (SSN-723)

Lt. j.g. Luke Saladyga
USS Salt Lake City (SSN-716)

Lt. j.g. Brian Sofen
USS Salt Lake City (SSN-716)

Lt. j.g. Paul Stence, Jr.
SUBRON-6

Lt. j.g. David Stopp
USS Augusta (SSN-710)

Lt. j.g. Sean Thorne
USS Annapolis (SSN-760)

Lt. j.g. Errol Watson, Jr.
USS Hyman G. Rickover (SSN-709)

Lt. j.g. Paul Will
USS Augusta (SSN-710)

Qualified Nuclear Engineer Officer

Lt. Cameron Aljilani
USS Helena (SSN-725)

Lt. Taniel Anderson
USS Nevada (SSBN-733)(G)

Lt. Eric Astle
USS Cheyenne (SSN-773)

Lt. Joshua Collins
USS Asheville (SSN-758)

Lt. Robert Garis
USS Olympia (SSN-717)

Lt. Nicholas Lenczycki
USS Maine (SSBN-741)(B)

Lt. Michael Moore
USS Buffalo (SSN-715)

Lt. Paul Rose
USS Buffalo (SSN-715)

Lt. Thomas Sheldon
USS Bremerton (SSN-698)

Lt. Iradj Strobbe
USS Cheyenne (SSN-773)

Lt. Danny Stubbs
USS Houston (SSN-713)

Lt. Phillip Sylvia
USS Chicago (SSN-721)

Lt. j.g. Richard Arledge
USS Louisiana (SSBN-743)(G)

Lt. j.g. Christopher Ault
USS Louisville (SSN-724)

Lt. j.g. Vincent Avocato
USS Nebraska (SSBN-739)(B)

Lt. j.g. Scott Becker
USS Asheville (SSN-758)

Lt. j.g. Brian Borillo
USS Jefferson City (SSN-759)

Lt. j.g. Darrell Brown
USS Buffalo (SSN-715)

Lt. j.g. Casey Caldwell
USS Alaska (SSBN-732)(B)

Lt. j.g. Gilbert Canton
USS Honolulu (SSN-718)

Lt. j.g. Justin Carrell
USS Los Angeles (SSN-688)

Lt. j.g. Neil Cayabyab
USS Alabama (SSBN-731)(G)

Lt. j.g. Michael Charnota
USS Pennsylvania (SSBN-735)(B)

Lt. j.g. Joshua Chisholm
USS San Francisco (SSN-711)

Lt. j.g. Caleb Cramer
USS Salt Lake City (SSN-716)

Lt. j.g. David Crescitelli
USS Alabama (SSBN-731)(G)

Lt. j.g. Christopher Curatolo
USS Topeka (SSN-754)

Lt. j.g. John Eisenbraun
USS Nebraska (SSBN-739)(G)

Lt. j.g. Phillip Emery
USS Kentucky (SSBN-737)(G)

Lt. j.g. Christopher Fendley
USS Tucson (SSN-770)

Lt. j.g. Jeremy Fields
USS Kentucky (SSBN-737)(B)

Lt. j.g. William Gardner
USS Olympia (SSN-717)

Lt. j.g. John Genta
USS Chicago (SSN-721)

Lt. j.g. Ivan Geroy
USS Nebraska (SSBN-739)(B)

Lt. j.g. Adam Hattersley
USS Columbus (SSN-762)

Lt. j.g. Nicholas Herman
USS Alabama (SSBN-731)(G)

Lt. j.g. Erick Johnson
USS Alaska (SSBN-732)(B)

Lt. j.g. Benjamin Kim
USS Pennsylvania (SSBN-735)(B)

Lt. j.g. Eric Kleen
USS Bremerton (SSN-698)

Lt. j.g. Bradley Krack
USS City of Corpus Christi (SSN-705)

Lt. j.g. Ryan Lamonica
USS Alabama (SSBN-731)(B)

Lt. j.g. Jeffrey Loebach
USS Alaska (SSBN-732)(G)

Lt. j.g. Gregory Marcinko
USS Henry M. Jackson (SSBN-730)(B)

Lt. j.g. Angel Martinez
USS Salt Lake City (SSN-716)

Lt. j.g. Charles Mello
USS Jefferson City (SSN-759)

Lt. j.g. Mathew Merten
USS Michigan (SSGN-727)

Lt. j.g. Matthew Mooshegian
USS Alaska (SSBN-732)(G)

Lt. j.g. Samuel Nakamine
USS Pennsylvania (SSBN-735)(B)

Lt. j.g. Justin Nassiri
USS Alaska (SSBN-732)(G)

Lt. j.g. Joshua Nevin
USS Salt Lake City (SSN-716)

Lt. j.g. Lester Patterson
USS Helena (SSN-725)

Lt. j.g. Charles Phillips
USS Pasadena (SSN-752)

Lt. j.g. Jeffrey Poirier
USS Greeneville (SSN-772)

Lt. j.g. Sean Ponder
USS Salt Lake City (SSN-716)

Lt. j.g. Bryan Reed
USS Chicago (SSN-721)

Lt. j.g. Joshua Smith
USS City of Corpus Christi (SSN-705)

Lt. j.g. James Southerton
USS Los Angeles (SSN-688)

Lt. j.g. Chad Summe
USS Topeka (SSN-754)

Lt. j.g. Keith Thompson
USS Nevada (SSBN-733)(G)

Lt. j.g. Mark Treen
USS Maine (SSBN-741)(B)

Lt. j.g. David Wakayama
USS Henry M. Jackson (SSBN-730)(B)

Lt. j.g. Scott Washburn
USS Louisville (SSN-724)

Lt. j.g. Michael Weber
USS Nebraska (SSBN-739)(B)

Lt. j.g. Keagan Wisdom
USS Alabama (SSBN-731)(B)



Qualified Surface Warfare Officer

Ens. George Cantu
USS Emory S. Land (AS-39)

Ens. Jeffrey Carideo
USS Emory S. Land (AS-39)

Supply Corps Officer Qualified in Submarines

Lt. j.g. Ian Iliff
USS Augusta (SSN-710)

Lt. j.g. Raymond Slusar
USS Newport News (SSN-750)

Limited Duty Officer Qualified in Submarines

Lt. Corey Hurd
USS Dolphin (AGSS-555)

Engineering Duty Officer Qualified in Submarines

Lt. j.g. Jack Tappe
PSNY & IMF

DESI: Diesel Electric Submarine Initiative A Partnership for Global Security

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A Global Transformation after 9/11

The events of September 11, 2001, have done more to make the United States a international security partner than any other event in recent history. In their Nov. 2005 U.S. Naval Institute *Proceedings* article, Vice Adm. John G. Morgan Jr., and Rear Adm. Charles W. Martoglio noted, "It will take a fleet in excess of 1,000 ships to address all the new challenges, more complex contingencies, and broader range of maritime missions. The challenge is for individual nations to come together by determining where their national interests intersect and to determine what contribution they can make to this already-emerging network to meet those common interests. Plugging into a regional or global maritime network will not be a one-size-fits-all proposition."

"Capabilities that cover the spectrum from blue-water operations to maritime law enforcement will play important roles in delivering the kind of maritime security that is helpful to the global community, and that means virtually every nation can contribute in some way to security in the maritime domain," the *Proceedings* article

noted. "While individual navies have vastly different capabilities, it is their synergy when voluntarily coordinating maritime activities that yields a network in which regional and local results are determined by regional and local interests."

"Maritime Security" used to begin and end at a country's territorial waters or national borders. Transnational threats, environmental attacks, human trafficking, or failed states weren't expected. But the days of relatively simple maritime security and well defined threats are gone.

"I think the real potential of Sea Power lies in exploring those kinds of possibilities, while developing global awareness," said Adm. Mullen during his August speech. "It is about international maritime relationships founded on understanding and trust, enduring relationships that bloom into partnerships. Our vision is...and ought to be...to extend the peace through an interconnected community of maritime nations working together. The enemy goes global. So should we."

Chief Petty Officer Fliesen supports the COMSUBLANT Public Affairs Office in Norfolk, Va.

Virginia-class Submarine Program Team Wins 2005 Defense Standardization Program Office (DSPO) Achievement Award

by Team Submarine Public Affairs

The Defense Standardization Program Office (DSPO) recently selected the Program Executive Office for Submarines' Virginia-class Submarine Program Team (VCSPT) as Navy recipients of the 2005 DSPO Achievement Award.

DSPO annually recognizes individuals and organizations from military departments and defense agencies that have achieved significant improvements in interoperability, cost reduction, quality, reliability, and readiness through standardization. DSPO also holds an annual ceremony to congratulate winners of this award. This year's ceremony will be held during the Department of Defense Standardization Conference scheduled for May 23, 2006.

VCSPT won the DSPO Achievement Award for its work in Life Cycle Savings Through Standardization (LCSTS) project. This program turned to standardization to reduce the overall acquisition, operation, and maintenance costs of the Virginia-class program. Consequently, the Virginia-class Program Office (PMS450) Integrated Product and Process Development strategy was able to reduce PMS 450's overall logistics footprint.

The LCSTS project also condensed the Virginia-class submarine parts library before the first ship of the class, USS *Virginia*

(SSN-774), was delivered on October 12, 2005. When *Virginia* was delivered to the Navy it was the best logistically prepared lead ship of any class, as evident from the Board of Inspection and Survey results.

One metric of success is PMS 450's \$27 million investment in parts standardization. The Navy estimates that this will result in a cost avoidance of up to \$789 million over the life of the Virginia-class Program. The impact of this and other standardization successes has led to projected cost avoidance of \$80 million for the SSGN submarines, and \$72 million for USS *Jimmy Carter* (SSN-23).

The project has not only saved taxpayers hundreds of millions of dollars, but has enhanced the Navy's reputation for sound stewardship of public shipbuilding and acquisition funds.

"Receiving the DSPO Achievement Award validates the Virginia-class program's on-going efforts to reduce costs by streamlining the construction process," said Rear Adm. William H. Hilarides, Program Executive Officer (Submarines). "The Program Office is working tirelessly," the Admiral continued, "so that we can deliver these tremendous platforms to the warfighter without overburdening the taxpayers."

The Art of the Possible – Communications at Speed and Depth

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the communications. Additional testing off the Hawaiian Islands in the fall demonstrated a submarine-deployed long-range acoustic pager, which would allow a submarine to be “on call” while performing operations at considerable speed and depth, much greater than those at which the BCA can be used. Follow-on demonstrations in 2006 will showcase expendable, fiber-tethered communications buoys that provide the submarine a two-way, telephone-like capability to respond to the acoustic pager without interrupting its normal operations at speed and depth.

The Submarine Force’s highest priority needs will be addressed using the technology and budget available in the near-term. More complex and innovative technology solutions will be budgeted and developed for mid-term deployment. In the far-term, the fielded capability would fully implement performance objective requirements.

“About 90 percent of everything we’re looking at so far,” Richter offered, “is aimed at all in-service nuclear submarines – attack subs [SSNs], ballistic missile submarines [SSBNs], and the four *Ohio* [SSBN-726]-class ‘boomers’ that are being converted to SSGNs configuration. Only about 10 percent of the solutions are class-specific, and those typically consist of the larger towed communications buoys for the SSBNs and SSGNs, as well as future *Virginia* [SSN-774]-class attack submarines with the Advanced Sail.”

As always, real-world physics is the limiting factor in the Navy’s pursuit of a “Holy Grail” communications solution. “Most of the navies around the world which operate submarines – including the United States – have been using communications buoys for years,” Richter said. “The problem today is that those buoy systems were typically one-way and are rapidly becoming obsolete as satellite communication technology advances. The near-term solutions take advantage of modern satellite communications and rapidly improving computer electronics to provide a higher data rate, two-way networked communication capability to the operational commander.”

No “Silver Bullet”

“We’re looking at several technologies to provide the requisite capability,” Richter explained. “Some technologies lend themselves to high data rates but limit the submarine operations in speed and depth. Other technologies provide a lower data rate but can be employed at greater speeds and depths. Still others offer a low probability of intercept to help us maintain stealth.”

The candidates include ELF and VHF, acoustic, and laser comms solutions focused on:

- Legacy antennas
- One- and two-way expendable optically-tethered communication buoys
- Acoustic communications linking submarines-to-submarines, submarines-to-unmanned underwater vehicles, submarines-to-acoustic gateway buoys.
- Acoustic-to-RF gateway buoys of various sizes and capabilities, including one-way tactical pagers, and two-way buoys

- Larger optically tethered two-way buoys, and towed buoys
- Optical one- and two-way systems (e.g., the “SeaDeep” laser optical communications link between a submarine and an aerial platform)

“There is no CSD ‘silver bullet,’” Richter explained, “and one size does not fit all. Not a single one of these solutions gives us a high data-rate capability at all conceivable depths and speeds in all major ocean areas of the world. They all have their pros and cons. That’s why we’re focused on developing a family of systems to provide the strike group commander and the submarine commanding officer a variety of options to choose from based on the current tactical situation.” One such concept called “SeaWeb” would offer bi-directional communications between patrolling submarines, the in-theater commander, and a multitude of off-board undersea (both buoyant and seabed) “nodes” in the undersea FORCEnet.

There are several promising solutions that could meet nearly all of the Navy’s future needs, but those technologies are still in the developmental stages and require further progress and seasoning. In the meantime, the service is focusing on long-term research and development efforts – developing, testing, and procuring near- and mid-term solutions in order to provide the maximum capability to the fleet in the shortest amount of time. And, they are not being constrained by a “not-invented here” prejudice, as the service looks to the most cost-effective solution.

“Several U.S., U.K., and Canadian companies are involved in CSD R&D efforts and promise to compete favorably for future CSD contracts,” Richter said. For example, a Lockheed Martin-Sippican team has a complete line of buoyant wire antenna systems capable of operations in the VLF-HF communications bands while the submarine remains submerged at tactical speeds and depths. Also, the team’s expendable SSXCD buoy offers a near-term solution to CSD needs by providing a limited two-way UHF SATCOM link and can be configured to incorporate Iridium, photonics, other sensor packages, and GPS intercept. The latter is also being addressed by the Johns Hopkins University Applied Physics Laboratory (JHU/APL), which has demonstrated an at-sea capability to receive GPS signals while the submarine was at a keel depth of some 400 feet and a speed of about three knots. JHU/APL is also working on thin-line UHF buoyant antenna elements and a High Frequency Structure Simulator-based slot antenna model to aid future antenna design and engineering.

Feedback Spurs Demand

“Feedback from the fleet has been simple and straight to the point,” Richter concluded. “The fleet desires that a modern CSD capability be procured and fielded as soon as possible. Specifically, it wants that enhanced capability...NOW!”

Communications are paramount to a warship. If you can’t communicate in today’s modern security environment from the sea, at best you will be irrelevant – at worst, you die.

Dr. Truver is the group vice president for Anteon Corporation’s Center for Security Strategies & Operations in Washington, D.C. Mr. Holian is an analyst with Anteon Corporation.



Forward Deployed



U.S. Navy photo by Mr. Paul Farley

U.S. Navy photo by Mr. Paul Farley

Photo by Petty Officer 2nd Class Carolla Bennett



(above) Crew members man the bridge of USS *Annapolis* (SSN-760) as she departs the harbor following a routine port visit to Crete, Greece.

(above inset) Crew members remove a shore power cable from *Annapolis* in preparation to depart the pier following a routine port visit.

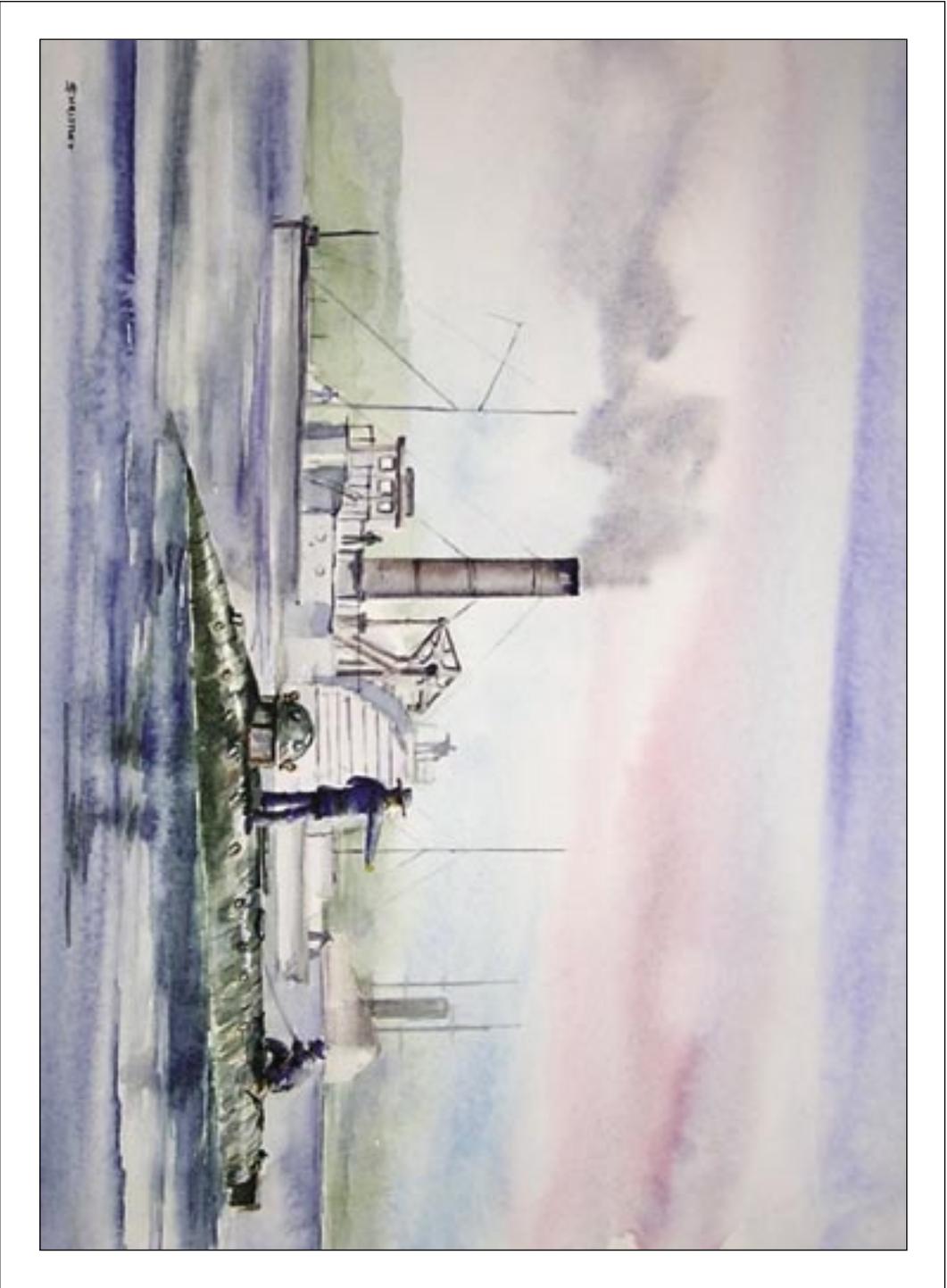
(left) The *Los Angeles*-class fast attack submarine USS *Norfolk* (SSN-714) is moored to the Mina Salman Pier in Bahrain during a brief port visit. *Norfolk* is currently deployed to the 5th Fleet area of operations in support of Maritime Security Operations (MSO). MSO set the conditions for security and stability in the maritime environment as well as complement the counter-terrorism and security efforts of regional nations.

On The Back



"*Alligator in the James, 1862*" by Jim Christley. This watercolor painting portrays *Alligator* – the first U.S. submarine – as it arrives off City Point, Va. in 1862. *Alligator* was sent to remove obstructions in the James River or destroy the railroad bridge at Petersburg to aid in General George McClellan's push to Richmond. This marked the first wartime forward area deployment of a submarine in naval history. In the background is the steam tug USS *Satellite* which was directed to provide berthing and messing for *Alligator's* crew.

Jim Christley is a historian in the *Alligator* Project, a project to study the history of – and perhaps find – *Alligator* which sunk in 1863. After serving for twenty years in the U.S. Navy, retiring as a submarine qualified senior chief petty officer, and working for another twenty years in the engineering field, Mr. Christley turned to traditional fine arts. The sea and its moods are the areas of primary interest for his work. He has studied with noted artists Lou Bonamarte, Gerald Levey, and Robert Spring. Mr. Christley's work is on display at the Brick Gallery in Essex, Conn. and the Lyme Art Association in Old Lyme, Conn. His paintings can also be found at the Naval Historical Center, Office of Naval Research, and the Submarine Force Library and Museum in Groton, Conn.



“Alligator in the James, 1862”

by Jim Christley