

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

U.S. Naval Shipyards: Keeping the Fleet at Sea

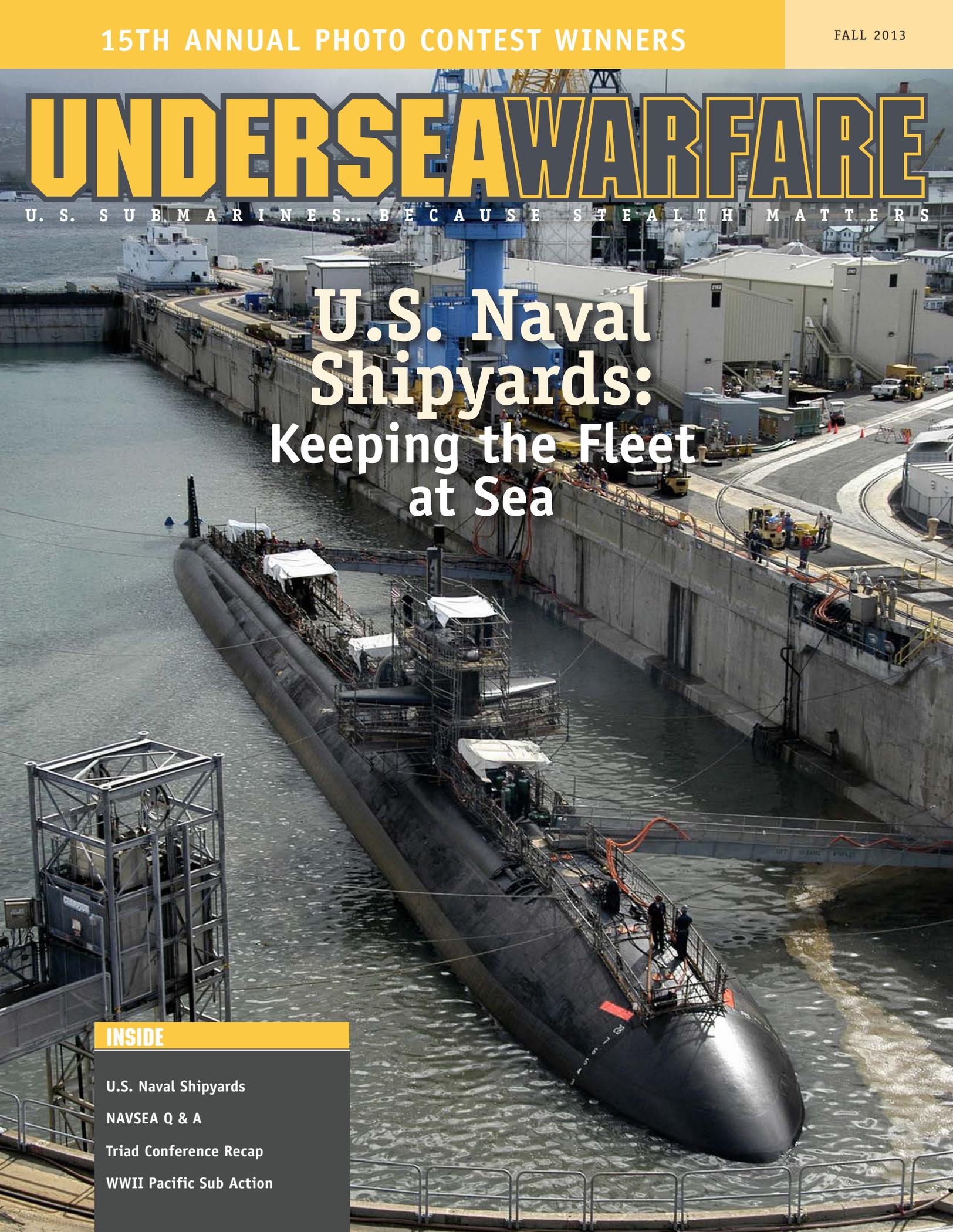
INSIDE

U.S. Naval Shipyards

NAVSEA Q & A

Triad Conference Recap

WWII Pacific Sub Action





U.S. Naval Shipyards

KEEPING THE FLEET AT SEA

4 U.S. Naval Shipyards: Supporting the Fleet Today and Planning for the Future

by NAVSEA Public Affairs

- Norfolk Naval Shipyard 5
- Portsmouth Naval Shipyard 7
- Puget Sound Naval Shipyard 9
- Pearl Harbor Naval Shipyard 11

14 Q&A with Jim Wrzeski

by Bill Woodbridge, NAVSEA 04X

18 WWII Submarine Warfare in the Western Caroline Islands

by Rolfe L. Hillman and Thomas Lee

24 Sustaining the Triad: The Enduring Requirements of Deterrence

by Lt. Andy Freeman

On the Cover



The *Los Angeles*-class attack submarine USS *Buffalo* (SSN 715) undocks from Dry Dock 2 at Pearl Harbor Naval Shipyard. *Buffalo* is undergoing a five-month scheduled maintenance period.

Photo by Marshall Fukuki

Departments

- 1 | Force Commander's Corner
- 2 | Division Director's Corner
- 3 | Letters to the Editor
- 27 | Downlink

FORCE COMMANDER'S CORNER

Vice Adm. Michael J. Connor, USN
Commander, Submarine Forces



Happy Holidays! As we enter the remaining days of 2013 and the beginning of the holiday season, I trust those who are blessed to be home for the holidays are able to spend some well-deserved time with friends and families. For those who are away, thank you again for keeping the watch.

This edition of *UNDERSEA WARFARE* Magazine focuses on our Naval Shipyards. There is simply not enough appreciation for the men and women who put in the hard work necessary to repair and modernize our ships, keeping them in excellent material condition, ready for operations throughout the oceans of the world. As our force ages and submarines approach their expected service life (and in some cases more), maintaining the fleet is becoming more challenging. Getting all the necessary repairs done in the future requires an ongoing commitment to invest in our repair capability, plan maintenance carefully, and execute maintenance with precision. Our naval shipyards rise to these challenges. They continue to deliver world-wide, quality maintenance, returning ships to the material readiness required by the United States Navy and the men and women who serve on them.

“Every man and woman who fights, supports, and repairs our ships is a member of this elite, high performance team and is fundamental to our undersea success.”

As Submariners, we will continue to capitalize on our unique capability to access denied areas, enable follow-on joint force access, and continue to fight on the leading edge. Every man and woman who fights, supports, and repairs our ships is a member of this elite, high performance team and is fundamental to our undersea success.

I am proud of you all.



M. J. Connor



DIVISION DIRECTOR'S CORNER

Rear Adm. Rick Breckenridge, USN
Director, Undersea Warfare Division

Happy Holidays from the Pentagon! In this issue of *UNDERSEA WARFARE*, our focus is the naval shipyards: Portsmouth, Norfolk, Puget Sound, and Pearl Harbor. The hard-working men and women of these activities play a vital role in our Force's success, conducting the depot maintenance and repairs that are crucial to keeping our submarines operating safely at sea. They are one important component of the success that has allowed us to extend the service of our current submarines well beyond their planned lives. The *Ohio*-class SSBNs, for instance, will serve an incredible 41-years each—40% longer than initially envisioned!

That's one of the points I made in my remarks at the "Sustaining the Triad" conference held in Kings Bay last month. We brought together strategic deterrence stakeholders from the Navy, Air Force, industry, and think tanks to discuss the vital importance of this national mission and how we can effectively communicate that importance to our nation and our communities at the grassroots level. In a way, we're the victims of our own success. Nuclear deterrence has, for over 68 years, kept our nation safe and essentially eliminated the threat of great power war. As a result, violence has been pushed down to much lower levels: instead of the hundreds of thousands

of Americans killed in the Second World War, for example, we now see casualty figures that are lower by orders of magnitude.

Americans have grown used to the effects of this nuclear insurance policy, and now we're facing the challenge of "over-optimized" strategic forces. The Air Force's newest nuclear bomber rolled off the assembly line more than half a century ago, and their Minuteman III intercontinental ballistic missiles (ICBMs) have been in service for over four decades. Assuming we avoid further delays, our first *Ohio* Replacement SSBN will deliver just in time to relieve the *Ohio* class, which will inactivate at the end of their extended service lives as the longest-serving nuclear submarines in history. Four *Obios* will have already decommissioned when the first *Ohio* Replacement makes a strategic patrol; we will be walking the razor's edge of operational risk. We have taken every bit of slack from our strategic forces and stretched them to capacity.

All the while, our defense has consumed a smaller and smaller slice of the nation's resources. From 1965 to 2010, the gross domestic product of the United States has gone up by a factor of 3.7 in constant-year dollars. This means that, as a country, we produce 3.7 times as much value in goods and services as we did in 1965. In the same 45 years, the sum total of all non-defense federal spending—on things like education, training, employment, social services, health, medical care, income security, disability, Social Security, and veterans benefits—increased by over 11 times. Defense spending increased by a factor of just 1.7. And in the meantime, our population has increased by about 50%. What this means is that, though we're three times wealthier than we were, per American, we're spending less on defense than we did in 1965.

So we are looking to invest in the continuation of this national imperative, our strategic deterrent, at a time when there is perhaps less appetite than ever for defense spending. And we're looking out at a world full of nuclear-armed adversaries that don't share the commonly held view that the world is growing safer. They are arming themselves to increase their ability to intimidate. What we need

to remember is that we are in a never-ending contest to provide our own security. We're in a chess match with opponents who are strengthening their positions with each move while we give away turns. They are only too happy for us to lose our focus and shift priority away from the things that keep us strong and safe.

What can we do? Keep doing your job faithfully and well, providing the security that Americans depend on every day, often without realizing it. Remember what an important role you play in our national defense and, when you have the opportunity, teach. Remind your family and friends that, while our strategic deterrent helped win the Cold War, its vital importance didn't end there.

"Keep doing your job faithfully and well, providing the security that Americans depend on every day, often without realizing it. Remember what an important role you play in our national defense and, when you have the opportunity, teach. Remind your family and friends that, while our strategic deterrent helped win the Cold War, its vital importance didn't end there."

R.P. Breckenridge

UNDERSEAWARFARE

The Official Magazine of the U.S. Submarine Force

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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 views 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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LETTERS TO THE EDITOR

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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FROM THE EDITOR

UNDERSEA WARFARE Magazine is updating its records. If you are a subscriber to UWM and have moved in the past two years, please notify us of your new address. Send any changes to underseawarfare@navy.mil.

In the Summer 2013 edition of the magazine, on page 27 we published an incorrect biographical note for James Scott, the author of *The War Below*. James Scott is an award-winning writer and former reporter and investigative journalist. His *The Attack on the Liberty* won the 2010 Rear Admiral Samuel Eliot Morison Award for Excellence in Naval Literature." We sincerely regret the error.

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SAILORS FIRST



Sonar Technician (Submarines) 1st Class Jeff Wansart receives the "First Hug" from his family following the return of the *Los Angeles*-class attack submarine *USS La Jolla* (SSN 701) to Joint Base Pearl Harbor-Hickam after completing a six-month deployment to the western Pacific region.

Photo by Mass Communication Specialist 2nd Class Steven Khor



U.S. NAVAL SHIPYARDS:

Supporting the Fleet Today and Preparing for the Future

The four U.S. naval shipyards, located in Norfolk, Va.; Kittery, Maine; Bremerton, Wash.; and Pearl Harbor, Hawaii, perform depot- and intermediate-level maintenance, modernization, emergency repair work, and inactivation for the U.S. Navy's nuclear-powered aircraft carriers and submarines. Unlike the multiple private shipyards located around the country, the four naval shipyards are owned and operated by the Navy, with government employees conducting the majority of the work.

With a \$4 billion annual operating budget, the shipyards provide critical services such as reactor plant servicing; nuclear-powered ship propulsion plant work; reactor compartment disposal and ship recycling; damage repair and intermediate-level work; ship maintenance engineering, planning, and project management of complex availabilities; and ship maintenance training for sailors and civilians. Work is performed primarily onsite at the four geographically dispersed naval shipyards, but also is performed on deployed ships as well as major fleet concentration areas such as Guam; Bahrain; Yokosuka, Japan; San Diego, Calif.; Kings Bay, Ga.; New London, Conn.; and Jacksonville, Fla.

Though once known for ship construction, the past few decades have seen the Navy move its shipbuilding operations to private yards, allowing the naval shipyards to focus strictly on ship repair.



Norfolk Naval Shipyard

Norfolk Naval Shipyard (NNSY) is the nation's oldest continuously operating shipyard and one of the Navy's largest industrial facilities. Located along the southern branch of the Elizabeth River in Portsmouth, Va., it was founded Nov. 1, 1767, under the British flag by Andrew Sprowle, a Scottish-born entrepreneur.

NNSY, a full-service shipyard employing approximately 9,500 people, specializes in maintaining and modernizing surface ships and submarines. Across its five dry docks and four major piers, NNSY is capable of servicing each of the Navy's submarine classes, nuclear-powered aircraft carriers, and large-deck amphibious ships.

A History of Firsts

NNSY can boast several Navy shipbuilding firsts. The first Navy battleship (USS *Texas*, launched in 1892), the first modern cruiser (USS *Raleigh* (C 8), launched in 1892), and the first aircraft carrier (USS *Langley* (CV 1), launched in 1912) were all completed at Norfolk. The first submarine serviced at NNSY (then named Norfolk Navy Yard) was the Navy's first commissioned submarine, USS *Holland* (SS 1), in 1901.

Submarines serviced during subsequent years at the shipyard were of the *Plunger* (SS 2) class, used to train Navy personnel in submarine operations. USS *Adder* (SS 3),

boasting considerable improvements over *Holland*, was 64 feet long, displaced 107 tons, and could dive to 100 feet.

Norfolk Navy Yard accomplished great feats with the surface fleet during the early 1900s, with its personnel preparing the Great White Fleet for steaming on its 46,000-mile diplomatic circumnavigation of the world from December 1907 to February 1909. Then the outbreak of World War I in Europe impacted the shipyard, changing its size, facilities, types of work, and workforce.

During WWII, Norfolk Navy Yard served the U.S. Fleet as one of the most important U.S. and Allied shipbuilding and repair bases. From early 1940 to the end of WWII, the yard accomplished repairs, upgrades, and conversions on 6,850 naval vessels. At the same time, 101 new ships and landing craft—including three 34,800-ton *Essex*-class aircraft carriers—were built for the fleet and millions of dollars in manufactured products were produced.

After WWII, the Norfolk Navy Yard officially became Norfolk Naval Shipyard. NNSY reduced its activities, downsized its workforce, and helped the Navy decommission most of its mammoth fleet. The yard would again surge to support the fleet, this time for two smaller wars while venturing into nuclear propulsion work, in the early 1960s.

As a first step, the yard operated as a non-nuclear submarine repair facility. The Bureau of Ships sent an advance directive to the shipyard instructing it to get organized for nuclear work and begin training personnel. The preparations began with conventional submarine work to familiarize shipyard workers with submarines. Incorporating nuclear work included converting a center for charging batteries and performing other submarine work, adapting a diesel locomotive for a mobile waterfront battery charging unit, and improving utility systems.

NNSY was accredited for nuclear work in the summer of 1964, and its first overhaul and refueling of a nuclear vessel began



NNSY riggers test the swivel socket in the port escape trunk on USS *Newport News* (SSN 750).

U.S. Navy photo



U.S. Navy Photo

Bruce Daughtrey, NNSY welder, uses only one hand to guide a grinder attached to the zeroG arm while working on USS *Newport News* (SSN 750).

with the arrival of USS *Skate* (SSN 578) in April 1965. Three years of training for approximately 2,000 shipyard employees and acquisition of new facilities and equipment prepared NNSY for this inaugural task, which included alterations and modifications to increase the sub's quieting, safety, and reliability. Following its overhaul, it would continue in service for another two decades before being decommissioned in September 1986.

By the late 1980s, NNSY's submarine work focused on depot modernization periods for *Los Angeles*-class submarines. These were daunting overhauls that involved modernizing submarines rather than merely maintaining them.

Modern Marvels

NNSY effectively weathered reductions in force and the possible threat of closure during DoD's decade of downsizing in the 1990s. To better use taxpayer dollars, the concept of regionalization was introduced throughout Hampton Roads, where similar Navy commands and equipment were combined to reduce costs and improve efficiency.

By the early 2000s, the future was bright for NNSY's submarine workload. The first Trident submarine to be repaired at Norfolk, USS *Florida* (SSBN 728), arrived in May 2003 for conversion to a nuclear-powered cruise missile submarine (SSGN). By the end of its nearly three-year conversion, the sub boasted a wholesale change to her missile launching system, now designed to launch over a hundred Tomahawk cruise missiles in place of the 24 Trident submarine launched ballistic missiles (SLBM) carried

by an SSBN. *Florida* also received improved equipment and modifications to optimize her for intelligence, surveillance, and reconnaissance and special operations forces (SOF) support missions. Sailors were also able to enjoy expanded living and training areas on the submarine. Concurrent with the *Florida* work, Norfolk performed the SSGN conversion on USS *Georgia* (SSBN 729).

NNSY also completed the last major overhaul for USS *San Francisco* (SSN 711). According to many Navy leaders, the shipyard's work helped ensure the sub's survival when it struck an undersea mountain 350 miles south of Guam early in 2005. Despite heavy damage to the bow, the sub was able to return to Guam under its own power.

Preparing for the Future

In recent years, NNSY has embraced a back-to-basics strategy in executing submarine availabilities by collocating project teams and streamlining work processes. The first of several extensive engineered overhauls at the shipyard was done on USS *Newport News* (SSN 750), which arrived in late 2011. As this project began, the shipyard dedicated its first tool vending room and set up a submarine-adjacent fastener refit facility and ship extended worksite.

A zeroG arm was introduced for performing maintenance tasks on *Newport News*. The zeroG arm is a mechanical arm that allows workers to maneuver tools and payloads with greater range of motion and gives a sense of weightlessness to heavy objects such as grinders and welding equipment. It is now used

by NNSY and two other naval shipyards, Puget Sound and Portsmouth.

NNSY recently completed its fifth overhaul on a Trident submarine, with USS *West Virginia* (SSBN 736) leaving the shipyard on October 24. In addition to refueling, other major work prepared *West Virginia* for its next 20 years of service. Some of these jobs include reverse osmosis modernization, steering and diving system maintenance, charging water storage tank ship alteration, and missile tube maintenance.

USS *Maryland* (SSBN 738) has been undergoing an overhaul at NNSY since its arrival in December 2012. Over the course of *Maryland's* availability, NNSY personnel will refuel the boat's nuclear reactor and overhaul ship systems, including replacement of distilling plants with a reverse osmosis unit, replacement of the ship's service turbine generator rotor with a low-sensitivity rotor, installation of an upgraded 500-kw motor generator and local area network upgrades.

USS *Albany* (SSN 753) arrived at the shipyard Oct. 16 for its mid-life overhaul. *Albany* will spend approximately 29 months at NNSY for work that involves removing the shaft and the sonar dome for maintenance and modernizing its combat systems.

To bolster efficiency, the shipyard created a tool room in close proximity to the submarine. The tool vending room eliminates 1,300 man-miles of walking to a job site and generates a cost avoidance of \$800,000 annually. Workers are provided with access to 500 items, including low-cost tools and expendable items such as pliers, measuring tapes, screwdrivers, highlighters, gloves, and drill bits. The project team has also incorporated additional management training to streamline the project.

NNSY is currently preparing for the eventual homeporting of *Virginia*-class submarines at Naval Station Norfolk, planning for its unique technical, logistical, and certification requirements to support pier-side and dry-docking availabilities.

NNSY is also making improvements to its facilities, which includes a renovation and 69-foot expansion of Dry Dock 8 to accommodate the new *Gerald R. Ford*-class carriers. The shipyard's Pier 3 also completed renovations, with Piers 4 and 5 currently being renovated to create a "superpier." These initiatives are all part of the shipyard's overarching vision 2035 goal, which will improve NNSY's infrastructure, reinvest and update the waterfront, and ensure a state-of-the-art shipyard.



Portsmouth Naval Shipyard

Portsmouth Naval Shipyard (PNSY), located in Kittery, Maine, provides the Navy's submarine fleet with quality overhaul work in a safe, timely, and affordable manner. Highly complex assignments ranging from a few days to more than two years are routinely accomplished by experienced tradespeople at the shipyard, which has the capacity to handle any submarine in the U.S. Navy.

History

Established by the federal government in 1800, PNSY launched its first ship—the 74-gun ship-of-the-line USS *Washington*—in 1814. With the construction of a permanent dry dock in 1906, the shipyard mission of ship construction, overhaul, and repair was greatly enhanced.

During WWI, the shipyard workforce expanded to nearly 5,000 people and took on an additional and important role—submarine construction. WWII saw the civilian employment rolls swell to more than 21,000 men and women as more than 70 submarines were constructed during that time.

In 1917, the first submarine to be built in a U.S. naval shipyard, USS *L-8* (SS-48), was undertaken at Portsmouth. Intended primarily for coastal defense, the *L*-class boats were 168 feet long with two 450-horsepower diesel engines capable of 14 knots on the

surface and 10-1/2 knots submerged. The *L* boats were armed with four 18-inch torpedo tubes in the bow and were the first to carry a deck gun.

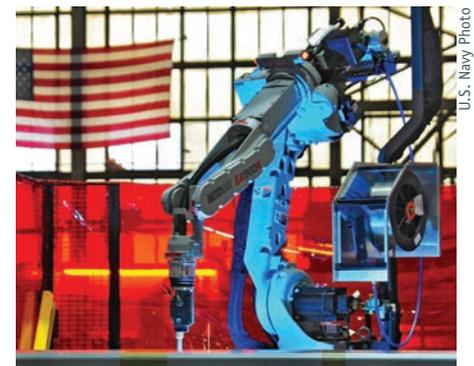
A leader in submarine construction, PNSY launched four submarines on the same day—USS *Razorback* (SS 394), USS *Redfish* (SS 395), USS *Ronquil* (SS 396), and USS *Scabbardfish* (SS 397)—on January 27, 1944, an accomplishment in submarine construction that has never been matched. Following WWII, Portsmouth was the Navy's center for submarine design and development. In 1953, the research submarine USS *Albacore* (SS 569), with its revolutionary tear-drop-shaped hull and round cross section, set the standard for all subsequent submarine hull design worldwide. At the time, it was the world's fastest and most maneuverable submarine. In 1958, PNSY built the first nuclear-powered submarine constructed in a naval shipyard, USS *Swordfish* (SSN 579).

Portsmouth continued to build submarines until 1969 when the last submarine constructed in a public shipyard, USS *Sand Lance* (SSN 660), was launched. PNSY's mission was then refocused to the repair, overhaul, and inactivation of the Navy's nuclear-powered submarines.

First-Time Quality Work

Today, PNSY's mission is to maintain, repair, overhaul, modernize, and inactivate nuclear-powered submarines. To accomplish this mission, shipyard workers perform complex and challenging tasks that require a great deal of technical expertise. The work of these men and women has a direct impact on warfighter readiness, with no room for error. In an environment where quality, time, and cost are of the essence, PNSY is committed to first-time quality work, which yields positive results in both cost and schedule performance.

In 2004, PNSY delivered six ships in a row back to the fleet, setting cost and schedule per-



Portsmouth Naval Shipyard integrated a new robotic metal inert gas (MIG) welder into the valve regulated lead acid (VRLA) battery cabinet fabrication process.



Learning centers allow mechanics to practice their skills in a realistic training environment prior to going to work on an actual vessel.

formance records in the process. PNSY highlighted its complex and substantial maintenance workload when it delivered USS *Helena* (SSN 725) as the fastest engineered overhaul in history, inactivated USS *Memphis* (SSN 691) 30 days ahead of schedule, delivered USS *San Juan* (SSN 751) eight days early, and most recently completing the pre-inactivation restricted availability on USS *Pittsburgh* (SSN 720) on time and under budget.

The Portsmouth Naval Shipyard Detachment, San Diego, was established in 2008 to provide intermediate-level maintenance to *Los Angeles*-class submarines homeported on the West Coast. In 2009, the detachment completed its first docking selected restricted availability for USS *Hampton* (SSN 767) two weeks early and, in 2011, completed the USS *San Francisco* pre-inactivation restricted availability on time and \$2.5 million under budget.

In an effort to reduce production welding time, PNSY has integrated a new robotic metal inert gas welder into the valve regulated lead acid (VRLA) battery cabinet fabrication process. PNSY is the sole provider of VRLA battery cabinets for *Los Angeles*-class submarines.

The cabinet fabrication process is extensive, with stringent interior dimension tolerances. To meet these high standards, a complex welding sequence was required to distribute heat across the cabinet and minimize distortion during the manual welding operation, a process that could take upward of eight hours. The robotic welder automates the process and completes the sequence in approximately an hour and a half, an 83-percent reduction in

the time required for the process.

The machine significantly reduces the final cleaning and grinding process as well. Manual welds required nearly eight hours of final cleaning and grinding compared to just four hours for the robotic welds, which has resulted in a 49-percent cycle-time reduction for this process.

Experience coupled with innovation and application of streamlined industrial practices has allowed PNSY to set new benchmarks in the performance of submarine maintenance, modernization, and overhaul work. While the Navy's *Los Angeles*-class submarines continue to be the shipyard's primary customers, Portsmouth ushered in the next chapter in submarine maintenance, performing the first-of-its-class major maintenance availability on USS *Virginia* (SSN 774).

Highly Qualified Workforce

As PSNY moves into the future, it has taken the lead in transforming the way shipyards prepare the next generation of mechanics for submarine maintenance work. Naval shipyards across the nation have been facing a critical challenge with a gap of experience in their trade skills workforce. At Portsmouth, 53 percent of the workforce has less than 10 years of experience while 29 percent are eligible to retire. Portsmouth is quickly narrowing this gap by embracing new opportunities to efficiently transfer knowledge and skills to the next generation and ready them for excellence.

The implementation of learning centers or mock-ups that consist of vessel components brought into shop spaces for use as training aids has greatly increased opportuni-

ties for hands-on learning for both new and experienced mechanics. Learning centers allow mechanics to practice their skills in a realistic training environment before going to work on an actual vessel. Learning centers also provide opportunities for constant refresher training, testing, and troubleshooting for real-world issues, making continuous learning part of the PNSY culture.

This innovative approach to mechanic development has produced results across the shipyard. This is exemplified by the more than 1,000 man-hour reduction in resources for the sonar sphere ship alteration on USS *Topeka* (SSN 754), currently undergoing maintenance at the shipyard. Hands-on learning is giving the next-generation workforce the skills it needs to continue the Portsmouth tradition of safely delivering first-time quality on time and on budget.

Safety is the highest priority at PSNY. Portsmouth implemented the Occupational Safety and Health Administration's Voluntary Protection Program (VPP), which encourages active union, management, and employee participation in safety and is focused on keeping people safe and reducing costs. In 2005, the Department of Labor and the Occupational Safety and Health Administration recognized PSNY for achieving star status in their VPP. Portsmouth was the first Navy activity to be so honored. In 2008 and again in 2013, the Department of Labor recognized PSNY's superb safety record and recertified the shipyard's star status.

Current Operations

PNSY currently has three submarines undergoing repairs in the yard. USS *Topeka's* engineered overhaul is off to a fast start. The project team and ship's force have built on the early momentum and continue to complete key milestones ahead of schedule. Planning and preparation are in full swing for USS *Miami* (SSN 755) inactivation, with deckplate work expected to begin in 2014. USS *Alexandria* (SSN 757) has just arrived and will undergo various repairs and several system upgrades as part of its overhaul.

At PSNY's San Diego detachment, intermediate maintenance is being performed on several submarines, including the pre-inactivation restricted availability on USS *Albuquerque* (SSN 706) and a continuous maintenance availability on USS *Oklahoma City* (SSN 723). Repairs and restoration of the Pressurized Rescue Module *Falcon* are progressing, with off-yard testing and repairs beginning this quarter.



Puget Sound Naval Shipyard

AND INTERMEDIATE MAINTENANCE FACILITY

Puget Sound Naval Shipyard (PSNS) and Intermediate Maintenance Facility (IMF) is focused on providing customers with high-quality, timely, and cost-efficient maintenance, modernization, and technical and logistical support. PSNS has sites in Washington at Bremerton, Bangor, and Everett and in San Diego and Japan. The shipyard is the largest command on Naval Base Kitsap, employing approximately 11,000 civilians and military personnel.

The Bremerton site is the Pacific Northwest's largest naval shore facility and one of Washington State's largest industrial installations. The shipyard has pioneered an environmentally safe method of deactivating and recycling nuclear-powered ships.

The Bangor site provides industrial support for the incremental overhaul and repair of Trident submarines using the Trident Planned Equipment Replacement Program (TRIPER) and applying rapid work induction to repair and retest components in order to meet tight operational commitments of the fleet. The facility's refit industrial operation trains Sailors in the journeyman mechanical rates using the Navy Afloat Maintenance Training Strategy (NAMTS) program, which ensures that essential at-sea repairs and refurbishments of major systems

can be completed without the need to return to port for corrective maintenance.

The Delta Pier at Bangor, so named because of its triangular configuration, can support five SSBNs at one time. It has one of the largest dry docks built by the Navy and is the only dry dock in the world constructed parallel to the shoreline.

A Look Back

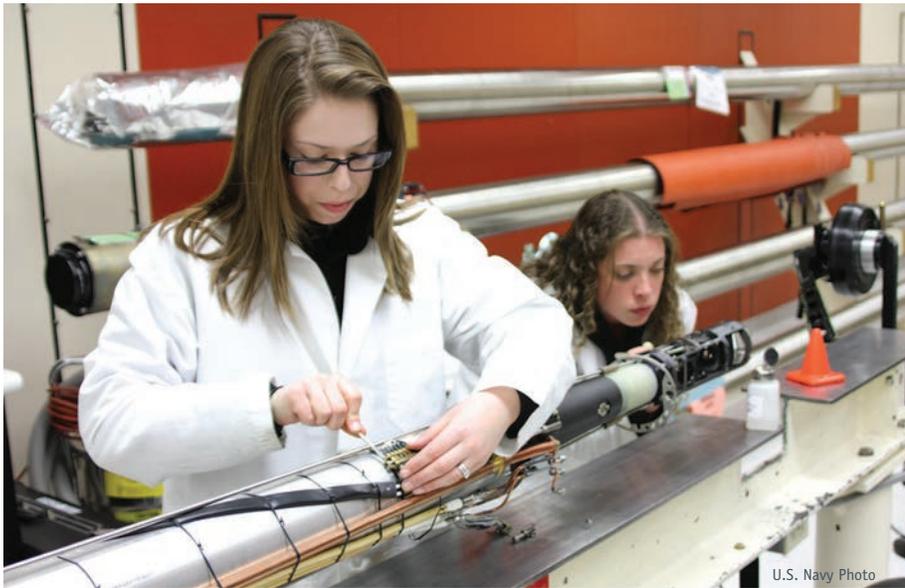
In 1891, as a result of growing national interest in the Pacific Ocean and a new American naval policy of a mobile battleship fleet, the U.S. Navy invested less than \$10,000 in 190 acres of Pacific Northwest wilderness and established Naval Station Puget Sound. Surveyed by Lt. Charles Wilkes in 1841, Puget Sound offered protected, deep-water port sites. In 1888, a Navy commission led by the noted naval strategist Alfred Mahan was appointed to select a site for a West Coast naval station north of the 42nd parallel. Lt. Ambrose Wyckoff finalized the purchase of the original 190 acres for \$50 an acre. He formally dedicated the opening of Navy Yard Puget Sound as its founding commandant the same day, September 18, 1891.

The first dry dock construction began in 1892 and was finished in 1896. With the beginning of the Spanish-American War

in 1898, the battleship USS *Oregon* (BB 3) sailed 17,000 miles from Navy Yard Puget Sound around South America to take part in the naval engagement at Santiago, Cuba. The fact that *Oregon* arrived ready to fight established Navy Yard Puget Sound's reputation throughout the fleet. Until WWII, Navy Yard Puget Sound would remain the only West Coast battleship repair facility.



Electro optical technician Jeb Monk tests and maintains electronic components on a periscope at the Northwest Optical Regional Repair Center (NORRC).



Electro optical technicians Amber Siva, left, and Leigha Campbell troubleshoot a periscope at the Northwest Optical Regional Repair Center (NORRC).

During WWI, many new ships were constructed at the shipyard, including 25 subchasers, two minesweepers, seven ocean-going tugs, two ammunition ships, and thousands of small boats. Between 1920 and 1940, Navy Yard Puget Sound improved its capabilities, enabling it to serve a key role repairing battle-damaged U.S. and Allied ships during WWII. Following the United States' entry into WWII, the facility repaired and modernized five surviving battleships from the attack on Pearl Harbor, USS *Tennessee* (BB 43), USS *Maryland* (BB 46), USS *Nevada* (BB 36), USS *California* (BB 44) and USS *West Virginia* (BB 48).

Throughout the war, the command repaired, overhauled, and refitted hundreds of U.S. and Allied ships, including 26 battleships, 18 aircraft carriers, 13 cruisers, and 79 destroyers. Navy Yard Puget Sound serviced nearly one-third of the 1,006 ships in the U.S. fleet. The workforce numbered more than 32,000 by 1945. By the end of WWII, Navy Yard Puget Sound was designated as a naval shipyard and its name was changed to Puget Sound Naval Shipyard.

During the 1950s, the shipyard's major effort was the extensive program of converting aircraft carriers' conventional flight decks to angled decks as the Navy entered the era of jet-powered aircraft. With the start of the Korean War, PSNS was busy reactivating ships and constructing two ships of the new *Farragut* class of guided missile frigates—USS *Coontz* (DLG 9) and USS *King* (DLG 10).

Between 1917 and 1970, a total of 85 major ships were constructed at PSNS, including the largest naval vessels built on the West Coast—*Sacramento*-class combat support ships. In the early 1960s, the shipyard was designated a repair yard for nuclear submarines, including the overhaul of ballistic missile submarines.

PSNS has the distinction of having several National Historic Landmarks within its gates, including 11 industrial buildings, five dry docks, five piers, and a hammerhead crane.

Established July 31, 1981, the IMF at Bangor became the primary maintenance facility for the West Coast Trident submarine fleet, a year before the arrival of USS *Ohio* (SSBN 726)—the first of the Tridents to be based in the Pacific.

By 1998, the area had grown into two military bases: PSNS—now a \$2 billion ship maintenance, modernization, and repair facility—and Naval Station Bremerton.

On May 15, 2003, PSNS and the Naval IMF Pacific Northwest consolidated into one command, creating PSNS & IMF. In addition to the shipyard consolidation, another opportunity to further improve fleet readiness and service arose in 2003. Surface ship maintenance organizations joined the command in standing up the Northwest Regional Maintenance Center, which provides maintenance for every class of Navy vessel.

The IMF, with its fully integrated workforce of civilian and military personnel, operates refit piers, repair shops, and a dry

dock in the homeport for all ships, aircraft carriers, and submarines in the Pacific Northwest. The workforce has expertise in hull, mechanical, electrical, electronics, and weapon systems repair and responds to meeting the fleet's maintenance and repair needs with on-time and cost-effective quality service.

Current Operations

Currently, four submarines are in varying stages of modernization and maintenance at the shipyard.

USS *Kentucky* (SSBN 737) began its engineered refueling overhaul in January 2012 and is expected to complete late next year. *Kentucky's* reactor has been refueled and the ship systems are being overhauled, which includes the replacement of distilling plants with a reverse osmosis unit and a battery replacement.

USS *Connecticut* (SSN 22) entered a depot modernization period in July 2012 and is scheduled to complete in summer 2015. *Connecticut's* ship systems are being similarly overhauled.

USS *Jimmy Carter* (SSN 23) began her docking phased maintenance availability last summer and is scheduled to complete in Fiscal Year 2014. *Jimmy Carter's* ship systems are being overhauled and modernized.

Finally, USS *Michigan* (SSBN 727) will be completing a major maintenance period this year, which includes preventive maintenance and repair.

The shipyard is proud of its history as a naval presence on the West Coast since 1891 and of its status as a world-class maintenance facility for the U.S. Navy. The combined organization is better equipped to continue to provide superb leadership and continuous process improvement in the areas of productivity, environmental stewardship, and technical innovation.



Photo by Ralph Wasmer, U.S. Navy

As part of the dismantlement process, submarines are defueled, their reactor components are removed, and all usable equipment and materials are removed and recycled.



Pearl Harbor Naval Shipyard

AND INTERMEDIATE MAINTENANCE FACILITY

Pearl Harbor Naval Shipyard (PHNSY) and Intermediate Maintenance Facility (IMF) serves as a one-stop regional maintenance center for the Navy's surface ships and submarines homeported in Hawaii. PHNSY's primary mission is to provide regional maintenance at the depot and intermediate levels on the U.S. Pacific Fleet's surface ships and submarines.

Strategically located in the mid-Pacific, the Navy's largest ship repair facility between the West Coast and the Far East is closer to potential regional contingencies in East Asia than sites on the West Coast.

With America's rebalancing in the Asia-Pacific region, PHNSY is not only the westernmost naval shipyard but also collocated with the Navy's largest submarine fleet concentration area. It is the full-service regional maintenance center for all Hawaii-based Navy maintenance activities, the parent shipyard for Guam-based submarines, and the go-to team for rapid emergent repairs from Hawaii through Southwest Asia.

PHNSY provides fly-away support for operations throughout the region, ship technical assessments, calibration, a dive locker, hazardous material management and hazardous waste disposal, cryptological equipment repair, oil and chemical analysis,

and natural disaster and emergency response. PHNSY also trains U.S. and foreign officers and sailors in shipyard management and maintenance.

As the largest industrial employer in the state of Hawaii, the shipyard has a combined civilian and military workforce of about 5,000.

A Long History

PHNSY is a symbol of America's rise as a Pacific power following the Spanish-American War at the end of the 19th century. In 1876, after years of discussions and negotiations, the Kingdom of Hawaii signed a Treaty of Reciprocity with the United States. Under the treaty, Hawaii would be



U.S. Naval Station Pearl Harbor, August 1919

able to sell its main crops, sugar and rice, in U.S. markets duty-free while the U.S. Navy would have exclusive access to Pearl Harbor as a coaling station, repair base, and anchorage. That base eventually became PHNSY.

However, Congress did not authorize funding to build the required facilities until the end of the century, when dredging allowed Pearl Harbor to be used by modern naval ships. Congress passed an act officially creating Pearl Harbor Navy Yard, Territory of Hawaii, in May 1908 and authorized nearly \$3 million to help build it. The shipyard quietly grew through the early part of the century, becoming an important Pacific base for the United States.

On Dec 7, 1941, Japanese aircraft attacked Pearl Harbor in two massive waves, damaging or sinking 18 of the major warships present. That morning, many PHNSY workers evaded bombs and machine gun fire to help Sailors and Marines and to put out hundreds of fires. Many were cited for their actions during and after the attack. PHNSY workers quickly recovered and returned 15 of those 18 ships to the war.

During WWII, perhaps the shipyard's most significant act was the repair job on the battle-damaged carrier, USS *Yorktown* (CV 5). Engineers estimated that the repair work would take four months to complete, but the PHNSY workforce, working 24-hour shifts, had her ready in 72 hours. The heroic effort of the shipyard workers enabled *Yorktown* to fight in the pivotal naval battle of the Pacific War—the Battle of Midway—joining two other U.S. carriers to even the odds against four Japanese carriers.



USS *Yorktown* (CV 5) under repair, May 1942

In December 1945, the name of Navy Yard Pearl Harbor officially changed to Pearl Harbor Naval Shipyard. PHNSY workers repaired 10,000 vessels, from small ships to mighty aircraft carriers, during WWII and the Korean war.

Recent Operations

Shipyard workers have performed a number of urgent repairs on Navy vessels such as USS *Denver* (LPD 9) in 2000, USS *Greenville* (SSN 772) in 2001, USS *San Francisco* in 2005, USS *Newport News* in 2007 and USS *Hartford* (SSN 768) in 2009.

Most recently, PHNSY began support on the Navy's next generation submarine, the *Virginia* class, in 2012. The shipyard set the gold standard for maintenance planning and operations for this new class and became a *Virginia*-class center of excellence as it prepared for USS *Texas*' (SSN 775) extended drydocking selected restricted availability. An availability of this complexity and magnitude is challenging under normal circumstances, but the fact that *Texas* is a *Virginia*-class boat meant that workers would be executing many jobs in the work package for the first time.

The innovations on the *Virginia*-class submarine include a fly-by-wire control system for improved shallow-water boat handling, unique special warfare support systems, and photonics masts that supplanted traditional periscopes required a new approach to maintenance. The modular construction, open architecture, and extensive use of commercial off-the-shelf components, as well as the relocation of the ship control room one deck away from the hull curvature, also presented new maintenance challenges that PHNSY managers and workers rose quickly to meet.

The shipyard began planning for *Virginia*-class submarines in 2005. These preparations included ensuring that facilities, tooling, equipment, instructions, material, and trained personnel were ready and available to support the Navy's newest class of attack submarines.

A partnership with Portsmouth Naval Shipyard was established to gain practical work experience and lessons learned from the USS *Virginia* availability. To ensure workforce proficiency on the *Virginia*-class systems, a knowledge-sharing plan was developed with PNSY for the workforce to gain hands-on practical work experience; PHNSY engineers and mechanics trained at industry shipyards and warfare centers, and mock-ups



USS *Texas* (SSN 775)

were developed for subject matter experts in high-risk, high-value, critical-path jobs. Additionally, the floor of Dry Dock 1 was hardened and leveled to accommodate equipment necessary for the removal/reinstallation of a *Virginia*-class propulsor.

Currently, PHNSY is the only fully qualified Navy facility capable of *Virginia*-class and *Ohio*-class photonics mast repair intermediate-level maintenance work. The PHNSY Photonics Lab can test, isolate, and repair photonics mast problems down to the lowest repairable unit. When a bad component is identified, the piece is swapped out and sent to a mainland repair facility and a replacement is sent back to the lab.

PHNSY's ability to troubleshoot *Virginia*-class and *Ohio*-class masts is a time- and money-saver for the Navy. Shipping the entire mast to the mainland is not only costly, but the manufacturer of these masts has a decreasing supply of spares due to the growing number of ships using photonics.

PHNSY & IMF has begun work on an overall facilities modernization plan scheduled to finish in 2035. The shipyard's modernization goals are to provide the right facilities to increase efficiency and improve safety and the quality of work life for shipyard workers while performing ship repairs. These goals will be achieved with execution of a \$600 to \$800 million plan, which includes building 10 new construction projects totaling 415,000 sq. ft., reducing 50 temporary or re-locatable structures, consolidating and collocating numerous functions across the shipyard, increasing capacity for two wet berths, and installing an intermediate caisson to extend capacity in Dry Dock 1.

Over the past four years, the naval shipyards have made changes to their processes to shorten the duration and lower the costs of shipyard availabilities, ranging from the simple—such as moving stores of the most commonly used tools closer to the waterfront—to the relatively complex—like the automating of underwater welding. This focused effort to improve productivity has allowed the shipyards to make significant strides in consistently completing submarine and surface ship availabilities on time and with noticeable improvements.

Our Navy doesn't just need submarines and surface ships, our Navy needs the most technologically advanced and modernized submarines and surface ships in the world. When the time comes for a submarine or surface ship to be overhauled or modernized, our Sailors need their vessels back on schedule and on budget. The naval shipyards are integral to making this happen. Only with the best shipyards and shipyard workers can these needs be met, enabling the Fleets to meet their operational objectives. Our Sailors deserve nothing less than the best submarines and surface ships possible, and the naval shipyards ensure that that is what they get.

Naval Sea Systems Command (NAVSEA) manages the four remaining naval shipyards, maintaining and upgrading naval vessels and overseeing the process of new ship construction to ensure that the highest quality ships are delivered to the warfighter. In 2009, NAVSEA instituted a “back-to-basics” initiative to reduce the time and cost required to complete submarine availabilities. This back-to-basics initiative is a refocusing on the basics of maintenance as well as what NAVSEA has to do to maintain production schedules and improve resourcing.



Question and Answer

Jim Wrzeski

Naval Sea Systems Command Assistant Deputy Commander,
Industrial Operations



As this issue of *Undersea Warfare* Magazine highlights the Naval Shipyards, we held a Q&A session with Mr. Jim Wrzeski. He is the Senior Executive for NAVSEA's Headquarters Management Group for the Naval Shipyards.

Mr. Jim Wrzeski was selected to the Senior Executive Service (SES) when he was chosen as the Nuclear Engineering and Planning Manager at Puget Sound Naval Shipyard in May 2003. There, he was responsible for all nuclear propulsion plant maintenance on the West Coast and the nuclear propulsion plant maintenance capability at Yokosuka, Japan. Before his selection to SES, Mr. Wrzeski served as the Shipyard's Head Nuclear Engineer, the Nuclear Refueling Engineering Division Head, the Reactor Compartment Disposal Division Head, and the Nuclear Facilities and Equipment Manager.

Early in his Shipyard career, Mr. Wrzeski attended and graduated from the Bettis Reactor Engineering School in West Mifflin, Pa., near Pittsburgh. Mr. Wrzeski also graduated from the Massachusetts Institute of Technology with a degree in mechanical engineering.

Q: We often talk about the tip of the spear and our deployed forces, but you work in an area that many of us don't think about that often. Tell us what's important about our naval shipyards and how they help the Submarine Force.

A: First, the naval shipyards ensure that, when our Navy's ships are deployed to sea, they are ready to meet the demands of their mission.

The four naval shipyards (Portsmouth, Norfolk, Puget Sound, and Pearl Harbor) are vital for fleet operational availability and mission success. They have the essential capability to do all types of depot- and intermediate-level maintenance, to do modernizations and emer-



gency repair work, and to do inactivations on nuclear-powered submarines.

To meet their mission, the naval shipyards need a highly qualified and skilled workforce. These dedicated men and woman are the backbone of the naval shipyards. We're focused on keeping and maintaining that workforce by providing our men and women with the training and tools that they need for their job.

We are also keen on revitalizing the workforce. Due to the Base Realignment and Closure (BRAC) process, several naval shipyards were closed during the 1990s. Coupled with declining workload because of the reduced number of ships, the number of shipyard workers dropped dramatically. What has happened over the years as a consequence is that the average age and number of years' experience of the shipyard workers are decreasing/getting lower, which reinforces the need to invest in training and development.

Q: What are you doing about that age gap?

A: A huge part of workforce revitalization is our apprentice programs, as we need to continue hiring at least 100 new apprentices annually at each naval shipyard. Maintaining viable trade skill apprentice programs is an important lesson learned from the late 1990s. The apprentice programs are the vital source for hiring and training the skilled workforce. The four-year apprentice program includes academic studies and trade theory

curriculum. We also have individualized on-the-job learning objectives defined for each unique trade discipline. As part of these efforts, I'm proud that we've had two of our naval shipyard programs recognized by the U.S. Department of Labor as Registered Apprenticeship Trailblazers and Innovators. These apprentice programs were recognized as being in the top 70 programs of the more than 25,000 apprentice programs registered with the Department of Labor.

In San Diego, Calif., the Navy has completed the third year of the Cooperative Apprentice Program. This program is led by Puget Sound Naval Shipyard and supports a partnership with Portsmouth Naval Shipyard (PNSY), the Southwest Regional Maintenance Center, and the Naval Air Systems Command depots in the San Diego area that handle the Navy's maintenance workload. The program seeks to produce highly skilled tradespeople who can execute the Navy's technical maintenance needs to meet readiness requirements today and who will fulfill key supervisory and managerial positions in the future. It's a great example of efficient investment in workforce development as it partners across multiple commands to build a quality workforce for today and lay the foundation of a longer-term investment in prospective leaders needed for the future.

In addition to the apprentice program, the shipyards have trade development programs where helpers are provided on-the-job training. The helpers receive limited academic



Photo by Jim Cleveland

USS Alexandria (SSN 757) enters Drydock #1 at the Portsmouth Naval Shipyard, Kittery, Maine where she is undergoing an Engineered Overhaul.

training, safety and trade technical training, and may attend additional academics classes on their own time. Successful helpers may apply to become apprentices or advance to intermediate and journey levels if they complete trade, academic training, and on-the-job work experience. We've found that the apprenticeship completion rates have improved for the shipyards that use these formal helper programs.

Our workforce revitalization initiatives are key to keeping a workforce with the balance of skills that we need. Looking ahead, the skill mix will be adjusted for new technologies, which will likely create a higher demand for electrical and electronics skills. Each fiscal year, naval shipyards use demographic data along with attrition history at the trade skill/skill code level to project estimated workforce requirements. Hiring plans are then based on the trade and support levels given the current workforce and the forecasted workload.

Q: What have the naval shipyards done for training the workforce on Virginia-class maintenance and repair work?

A: New skills are always required for new weapons systems, such as the Virginia-class fast attack submarine. To start with, we worked with the private sector to develop training for the shipyard workforce. This involved familiarizing shipyard personnel with the differences between 688 and Virginia-class subs. Specifically, training modules were developed and instructors traveled to each shipyard

Photo by Office of the Governor, State of Hawaii



The Pearl Harbor Naval Shipyard & Intermediate Maintenance Facility (PHNSY & IMF) Apprentice Program is a successful partnership between the Shipyard, the U.S. Department of Labor (DOL), and Honolulu Community College (HCC). Graduating Apprentices earn an Associate's Degree in Applied Trades and a certificate from the DOL.

to reach the maximum number of shipyard personnel with these modules.

Portsmouth and Pearl Harbor Naval Shipyards partnered on the first two Extended Drydocking Selected Restricted Availabilities (EDSRAs) on the USS *Virginia* (SSN 774) and USS *Texas* (SSN 775). Together they worked on identifying unique equipment and upgrades needed to support the availabilities. Additionally, Pearl sent over 100 employees to work with Portsmouth on *Virginia*, and Portsmouth has done the same for *Texas* at Pearl. PNSY passed many lessons learned from the *Virginia* to the *Texas* project, including the establishment of a process for purchasing material directly from Electric Boat if the Navy's supply system could not support requests for material. Portsmouth also partnered on training opportunities at Electric Boat during the initial planning phase. Portsmouth workers went to Electric Boat to observe construction of the submarine and get classroom instruction on its unique systems.

The ship's force also plays a vital role in the success of an availability. Acknowledging this has led to ensuring that the qualifications for the Limited Duty Officer for an availability are now spelled out in the Baseline Project Management Plan. This ensures that the officer has the necessary training to be an effective interface between the crew and the shipyard workforce. The submarine community has further integrated ship's force in the preplanning of availabilities with an addition to the integrated project team training. This is a two-day event with selected members of the core project team and the ward room of the boat. This part of the training is to discuss the expectations of the crew and to explain what the crew can expect from the shipyard. These discussions are meant to sketch out the road ahead and to work out compromises and detail any agreements reached. The biggest takeaway from this event is the building of a relationship that provides the backbone for communication throughout the availability.

Q: What else comes into play when you're looking at revitalizing the workforce at the naval shipyards?

A: I'd say that the next vital piece for revitalizing the workforce involves giving them the tools to do their job. In part, this means that we need to maintain or upgrade the infrastructure of our naval shipyards—the dry docks, shop buildings, and cranes and other heavy equipment that are the everyday tools



USS *Virginia* (SSN 774) undocks at Portsmouth Naval Shipyard, where she completed a 20 month Extended Drydocking Selected Restricted Availability—the first of a *Virginia*-class submarine.

of the workforce.

Much of the infrastructure of the naval shipyards was designed for World War II-era ship construction rather than nuclear-powered ship-repair processes. Also, the overall condition/configuration of this infrastructure is below the Navy average. This reduces their efficiency in repairing today's ships.

In April 2013, we delivered a report to Congress titled Investment Plan for the Modernization of the Naval Shipyards. The infrastructure plan focuses resources against needs. It takes a hard look at existing maintenance and recapitalization backlogs in each shipyard's infrastructure. We want to ensure the long-term mission effectiveness of the naval shipyards by focusing on five key areas of infrastructure to maintain the requisite depot maintenance capabilities:

- maintaining dry dock certification,

- eliminating the mission-essential facility maintenance backlog,
- remediating seismic deficiencies,
- centralizing maintenance operations for product lines in specific waterfront areas—the hub concept, and
- improving utility system reliability.

The industrial equipment used by our skilled labor force is critical to the success of the naval shipyards. The shipyard Capital Investment Program (CIP) is part of that success. It plans, develops, and executes industrial plant equipment projects, information technology, and personal property projects that cost more than \$250,000. These projects maintain, modernize, and improve the infrastructure and industrial base capabilities at the naval shipyards.

Capital Investment Program focus areas

- The inactivation of 688-class submarines. This creates the need for increased capacity at Puget Sound Naval Shipyard where a new complex at Dry Dock 5 is planned to support this work. This will give Puget the capability to simultaneously defuel two 688-class subs in Dry Dock 5 and one in Dry Dock 1 starting in Fiscal Year (FY) 2016.
- Shaft refurbishment for submarines and aircraft carriers is another major program. This CIP will replace and modernize shafting maintenance equipment at all four naval shipyards. This includes buying new computer numerically controlled (CNC) shaft lathes and honing machines. This state-of-the-art equipment will provide significant depot maintenance efficiencies for all ship classes. For example, it will reduce the amount of lifts required by at least half. These new shaft lathes and honing machines will be placed in service from FY14 through FY15.

JAPANESE MANDATED ISLANDS

While most of the storied exploits of U.S. Navy (USN) submarine warfare in World War Two took place well outside of the Western Caroline Islands, the Western Carolines saw their share of action.

Located about 800 miles southwest of Guam, 500 miles east of the Philippines, and 1,300 miles south of the main Japanese islands, the Islands consist of Yap, Woleai, the Ulithi atoll, and the Palau island group, including Babelthuap, Peleliu, and Angaur.

Japan's Presence

Japan acquired the Western and Eastern Caroline Islands, the Gilbert Islands, and the Mariana Islands minus Guam from the Germans after WWI. Japan made Truk its district HQ in the Eastern Carolines and Palau its district HQ in the Western Carolines. Palau also became Japan's South Seas Bureau HQ.

In the 1930s, the Japanese developed the fishing, phosphate, and agricultural industries and built infrastructure in their new territories. They built a submarine base at

Palau, as well as a military radio station on Yap and harbors, airfields, seaplane ramps, and military training bases throughout their Pacific holdings.

Strategic Value for Japan

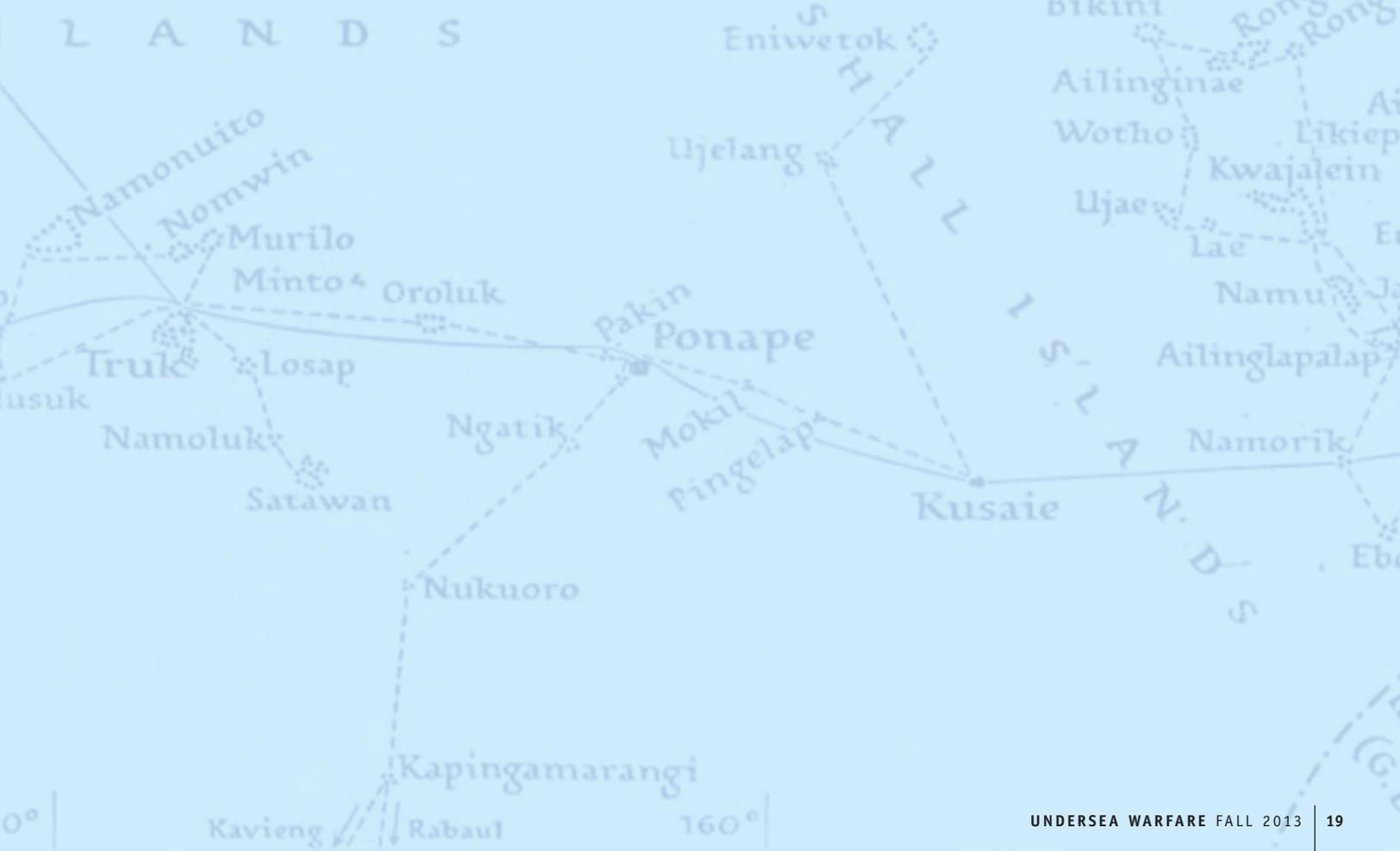
The Western Carolines were of vital strategic importance to Japan. They were central to all of Japan's Pacific island possessions and formed one layer in Japan's Pacific defense-in-depth strategy.

Japan was almost entirely dependent on

sea transport for acquiring the raw materials needed to fight the war. In the Western Carolines, Palau served as Japan's convoy operations center for the region, transporting troops, materiel, and raw materials between the Home Islands and possessions in the Marshall Islands, the Eastern Caroline Islands, the Gilbert Islands, the Dutch East Indies, New Guinea, and the Solomon Islands.

Passing through the Western Carolines on merchant ships on their way to Japan were phosphates, metals, rubber, food, and other vital raw materials. In the other direction flowed troops, airplanes, spare parts, and technical experts. Palau also happened to be the Imperial Japanese Navy (IJN) forward submarine base for the region.

Parts of the Japanese forces that invaded the Philippines, Rabaul, and Guadalcanal in 1941 were launched from the Western Carolines. Palau was Japan's district headquarters for the region, and after USN carrier and submarine operations destroyed the Japanese forces at Truk in February 1944, Adm. Koga relocated his headquarters westward to the relative safety of the island.



Japan's War Goals

Japan's plan was to destroy the U.S. Pacific fleet at Pearl Harbor, conquer the resource-rich Indo China, Malaya, and Dutch East Indies, build up Pacific islands for defense against American reprisals, including taking Midway and thus isolating Hawaii, and then finish subduing mineral-rich China. Much of this was accomplished in the first six months following the attack on Pearl Harbor.

Japanese attacks on Australia, the British in Malaya and India, the Dutch in the Dutch East Indies, and the United States in the Philippines and Guam between December 1941 and April 1942 were intended to convey the sense that Japan's forces were unstoppable. Their next goal was to negotiate peace with the Americans from a position of power and momentum with a cowed United States facing the specter of war in Europe. The Japanese would thus retain their newly expanded empire in the Pacific and avoid a long war.¹



USS Seawolf (SS 197)

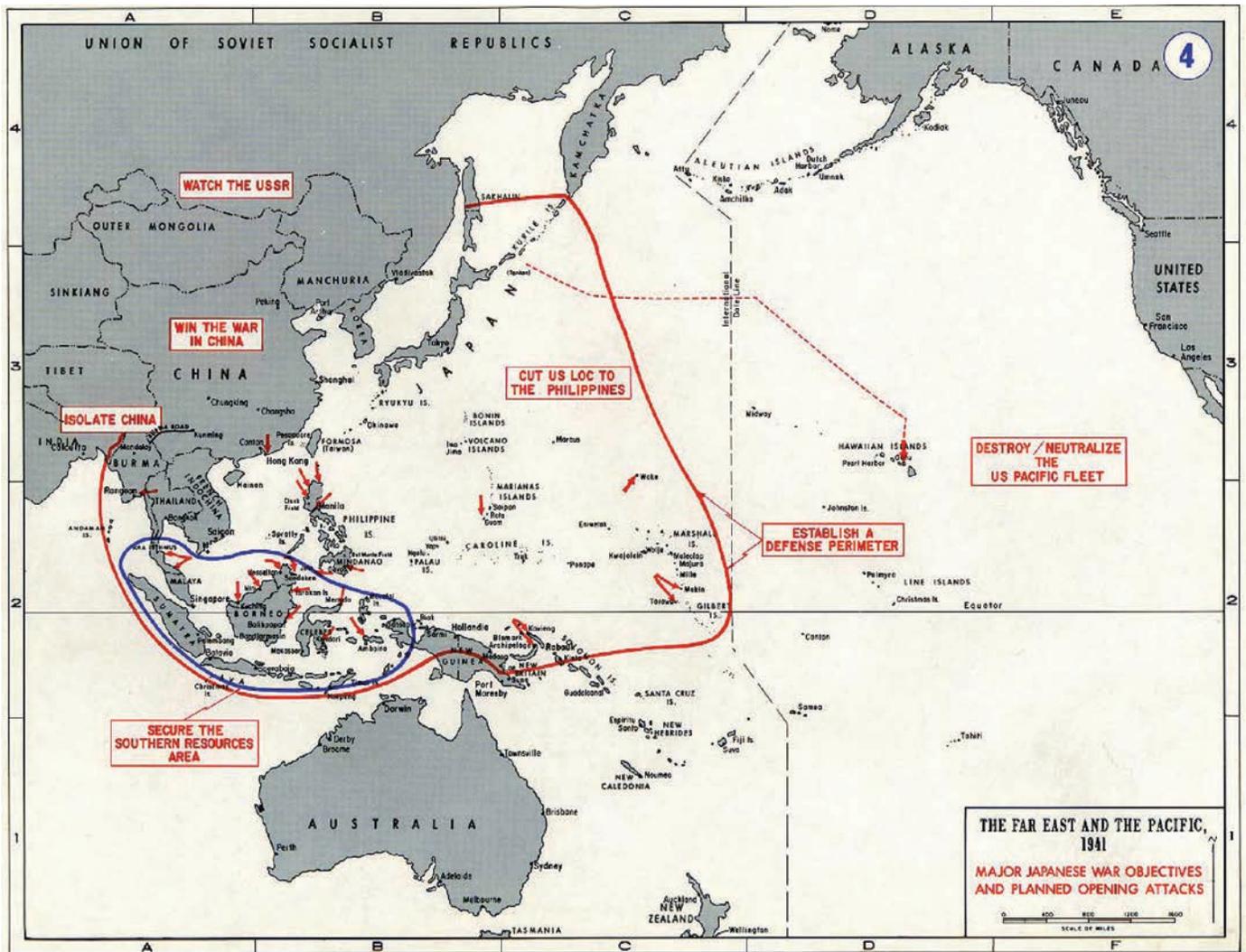
USN Submarine Operations

November 1942 saw the earliest USN submarine action in the Western Carolines. USS Seawolf (SS 197) and USS Seal (SS 183) were to pass through the Western Carolines from Fremantle on their way back to Pearl Harbor for overhaul. Seawolf arrived off Palau on November 11 to investigate reports of IJN aircraft carrier activity in the area. Upon her arrival, she spotted a carrier leaving Palau but was unable to gain attack position on it. Five

days later, Seal got close to an IJN convoy near Palau and fired torpedoes at a freighter, Boston Maru (5,500 tons), before diving. One of the ships, possibly an escort, rammed Seal, which was followed by a depth charge attack until the convoy was safely away. Seal survived the

Balao class Technical Information

Displacement	1526/2414 BRT
Length	312 feet
Complement	6 + 60 men
Armament	Ten 21" torpedo tubes, six forward, four aft, 24 torpedoes One 4"/50 deck gun One 40mm gun two .50 cal. machine guns
Max speed	20.25/8.75 knots (surfaced/submerged)
Engines	Diesel/Electric 2 shafts
Power	5400/2740 (surfaced/submerged)



USS Seal (SS 183)

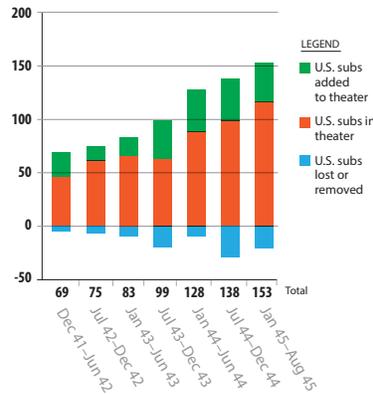


encounter; *Boston Maru* did not.

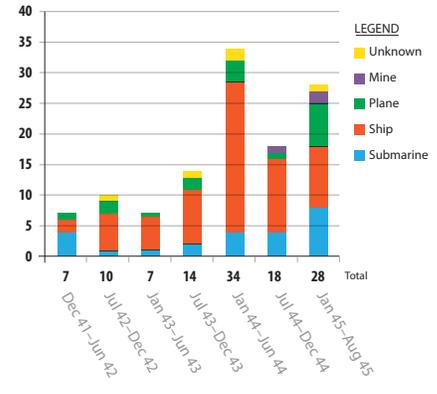
The first sustained attention given by the USN to the Western Carolines was in late March 1944. U.S. forces under Gen. Douglas MacArthur were about to invade northern New Guinea and didn't want the Japanese to provide air support to their troops there from air bases in the Palau. U.S. carrier planes struck the Palau on March 30-31, sinking or damaging 36 IJN surface ships and destroying about 160 airplanes. The carrier group then steamed past Yap and Woleai, attacking each in turn. During these attacks, codenamed Operation DESECRATE ONE, submarines USS *Archerfish* (SS 311), USS *Bashaw* (SS 241), USS *Blackfish* (SS 221), USS *Gar* (SS 206), USS *Tang* (SS 306), USS *Tullibee* (SS 284), and USS *Tunny* (SS 282) were stationed off Palau to intercept any IJN ships fleeing the attack; USS *Dace* (SS 247), USS *Darter* (SS 227), and USS *Scamp* (SS 277) were in position east of the Philippines to attack any ships escaping to Davao; and USS *Harder* (SS 257) and USS *Pampanito* (SS 383) were assigned lifeguard duty near Woleai and Yap.

USS *Picuda* (SS 382) was assigned to patrol the Western Caroline Islands on her first war patrol and, just past midnight on March 20, picked up by radar a small freighter with a single escort zig-zagging radically. *Picuda* spent the next two hours making an

USN submarines operating in the Pacific



IJN submarines sunk by U.S. forces



Data compiled from the Joint Army-Navy Assessment Committee (JANAC), Japanese Naval and Merchant Shipping Losses During WWII by All Causes, Chronological List of Japanese Naval Losses. <http://www.ibiblio.org/hyperwar/Japan/IJN/JANAC-Losses/JANAC-Losses-3.html>.

Data compiled from the following sources. D.L. Kimble, *Chronology of U.S. Navy Submarine Operations in the Pacific 1939-1942*, Merriam Press, Bennington, VT, 2012. Also, *FleetSubmarine.com*, World War II U.S. Submarine List. <http://www.fleetsubmarine.com/sublist.html>. Also, *Historic Naval Ships Association*, Submarine War Patrol Reports. <http://www.hnsa.org/doc/subreports.htm>.



USS *Picuda* (SS 382)

end-around run to get ahead of the ships, solving their zig-zag pattern to get their true course and speed as she went. Closing to within 1,300 yards, *Picuda* fired four bow torpedoes, the first two of which were observed to hit aft and amidships. *Picuda* went deep to secure for a depth charging that never came, and the crew heard a further explosion and the sound of *Hoko Maru* (1,504 tons) breaking up as she sank.

A day before Operation DESECRATE ONE, Adm. Koga, anticipating an airstrike on his new HQ at Palau, ordered his flagship, *Musashi*, to head for Davao in the Philippines to establish yet another headquarters. *Tunny*, however, was waiting just offshore and struck *Musashi* with a single torpedo. The torpedo put a 19-foot hole in *Musashi's* bow, killing some of her crew and flooding her hydrophone compartment. While not sinking *Musashi*, *Tunny's* torpedo sent her back to Japan for repairs.² Only a week earlier, *Tunny*

had sunk the IJN Type B2 submarine *I-42* in the same area.

During the airstrike on Woleai, *Harder's* crew made a daring rescue of a downed aviator who was within range of sniper fire from the shore. On April 13, an IJN destroyer, *Ikazuchi*, left the harbor at Woleai to search for *Harder*. Instead of diving, *Harder's* skipper, Cmdr. Sam Dealey, closed to 3,200 yards, at which point *Ikazuchi* picked up *Harder* on sonar and charged. Dealey waited until *Ikazuchi* was 900 yards away before firing four torpedoes down the throat. *Ikazuchi* sank quickly, her survivors blasted by the armed depth charges that had been prepared for *Harder*.

On April 16, still lurking near Woleai, Cmdr. Dealey saw a single freighter leaving with two destroyers as escorts. *Harder* tracked the vessels until nightfall, at which point she surfaced to attack. *Harder* torpedoed and sank the freighter, *Matsue Maru* (7,000 tons). *Harder* then returned to Woleai to bombard Japanese positions with its 4-inch deck gun before returning to Fremantle.

After U.S. forces captured the Mariana Islands in August 1944, Adm. Ernest King, Chief of Naval Operations, thought that taking Formosa and bypassing the Philippines and the Western Caroline Islands would be better than Gen. Douglas MacArthur's plan of slugging it out in the Philippines. Adm. King argued that, with Formosa in U.S. hands, USN submarines could effectively blockade Japan from getting oil and other commodities from Southeast Asia and leave troops outside the Japanese homeland stranded.³

Gato class Technical Information

Displacement	1526/2424 BRT
Length	312 feet
Complement	6 + 54 men
Armament	Ten 21" torpedo tubes, six forward, four aft, 24 torpedoes One 3"/50 deck gun Two .50 cal. machine guns Two .30 cal. machine guns
Max speed	20.25/8.75 knots (surfaced/submerged)
Engines	Diesel/Electric 2 shafts
Power	5400/2740 hp



USS *Harder* (SS-257) rescues Ens. John R. Galvin off Woleai Atoll. A Curtiss SOC Seagull floatplane participated in the rescue.

Despite Adm. King's arguments, the Joint Chiefs of Staff decided to go with Gen. MacArthur's plan to invade the Philippines. This meant first taking Palau, the stated reason being to prevent IJN forces there from interfering with the upcoming invasion at Leyte Gulf. The invasion of the Palaus, which commenced on September 15, 1944, was codenamed Operation STALEMATE II. Instead of preventing merchant vessels from reaching Japan with much needed war resources, more than a dozen U.S. submarines were sent to patrol between the Philippines and the Western Caroline Islands during the invasion and saw no action.

Between Operations DESECRATE ONE and STALEMATE II, USN submarines were occasionally sent to patrol in Western Caroline waters.

About an hour before midnight on April 26, USS *Trigger* (SS 237) picked up by radar a convoy of what was believed to be five ships and an escort 14,000 yards away about 50 miles north of Palau. Over the following hour, *Trigger* paced the convoy to determine true

course and speed and attain attack position. The convoy actually consisted of five large merchant ships, four of which were bunched in a tight group, with five escorts. *Trigger* had an ideal firing position between the escorts: the four bunched up freighters were overlapping and covered 20 degrees across her bow. At two minutes past midnight on the 27th, she fired all six bow tubes from 2,400 yards. The skipper observed two torpedoes hit the two nearer ships and heard two additional explosions hitting one or both of the two farther ships. One, *Miike Maru*, an 11,739-ton passenger-cargo ship, went down. *Trigger* relentlessly pursued the crippled convoy, making three additional attacks and claiming three additional freighters and one escort that were not confirmed by post-war IJN reports.

On April 27, USS *Bluegill* (SS 242), on her first war patrol, was southwest of Palau when she was spotted by the IJN cruiser *Yubari*. *Yubari* charged at *Bluegill*, according to the patrol report, "with large stern wake and bone in her teeth!" *Bluegill* fired her six bow tubes before diving. Two of the torpedoes found their mark, sinking *Yubari*.

On USS *Aspro's* (SS 309) third war patrol, she departed from Pearl Harbor and searched for IJN ships in the Western Carolines before proceeding to Fremantle. Spotting an IJN convoy on May 15, she fired four torpedoes at a freighter, sinking *Jokuja Maru* (6,440 tons).

Just before dawn on May 25, USS *Flying Fish* (SS 229) surfaced near a convoy she had chased from just north of Palau and loosed

four torpedoes at overlapping targets. *Taito Maru* (4,466 tons) and *Osaka Maru* (3,740 tons) burned for hours before their flames were extinguished by the enveloping sea.

On July 3, USS *Albacore* (SS 218) sank the 130-ton *Taiei Maru*, on its way from Yap to Palau, using her deck gun. Only five of *Taiei Maru's* survivors agreed to be taken onboard by *Albacore's* crew.⁴ USS *Balao* (SS 285) made good use of her 4-inch and 40mm deck guns during her sixth war patrol. On July 26, 1944, *Balao* bombarded Angaur Island, hitting a lighthouse, a loading dock, and a warehouse. On July 29, *Balao* joined USS *Drum* (SS 228) in a coordinated deck gun attack on two sampans until the Japanese abandoned ship and the sampans were destroyed.⁵

The only USN submarine lost in the Western Carolines is *Tullibee*. On March 26, 1944, while attacking a large troop transport north of Palau, one of her torpedoes malfunctioned and circled back on her, killing all but one of her crew.



USS *Albacore* (SS 218)

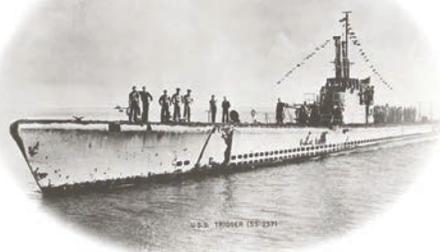
USN Non-combat Submarine Operations

The U.S. submarines operating in the Western Carolines had other missions besides anti-shipping attacks. Several boats were assigned lifeguard duties to rescue aviators who went down in the water during the bombing of the Western Caroline Islands and later during the invasion.

Prior to the invasion of the Western Carolines, a few subs conducted close-up reconnaissance to aid the invasion planning. *Seawolf* took extensive photographs of the Palaus and recorded enemy radar positions and frequencies during this time. During the Palau blockade, USN submarines inserted frogmen to conduct beach reconnaissance of Peleliu and Angaur, and *Seawolf*, USS *Permit* (SS 178), and USS *Burrfish* (SS 312) were sent to take beach photographs.

On their own initiative, some submarine

USS *Trigger* (SS 197)



skippers would pick up downed Japanese pilots or search floating wreckage of ships they had sunk for survivors when the situation allowed for it. Survivors often were quite willing to provide information on Japanese troop strengths, shipping schedules, and minefield locations.

IJN Submarine Operations

The IJN's primary submarine strategy was twofold: first, to conduct surveillance of enemy fleet units and bases and attack U.S. aircraft carriers, battleships, cruisers, and destroyers; a distant second were other missions, including anti-submarine warfare (ASW) and attacking U.S. lines of communication (LOC). Japan had envisioned a short war and did not have enough submarines in December 1941 (63 on December 7 with another 111 built during the war) to sufficiently interdict U.S. merchant traffic.⁶ Two of the IJN's noteworthy submarine successes, however, occurred in the Western Carolines.

The first of these attacks began with a reconnaissance mission. On October 2, 1944, IJN submarines RO-46 (*Kaichu* Type) and I-177 (Type KD7) were ordered to reconnoiter the Ulithi atoll in preparation for the first Kaiten attack on the U.S. Third Fleet, which was anchored there. The Kaiten was part manned mini-submarine, part suicide torpedo.

On November 20, IJN submarines I-36 (Type B1) and I-47 (Type C2), each carrying four Kaitens on their decks, maneuvered into position just outside the atoll. Of the eight, only five were able to launch. Of those, just one found a target, fleet oiler USS *Mississinewa* (AO 59), which exploded and sank. The successful Kaiten pilot, Lt. j.g. Sekio Nishina, was a co-inventor of the Kaiten. Both I-36 and I-47 made their way back to Japan, where optimistic IJN after-action assessments determined that the mission accomplished the sinking of two aircraft carriers and two battleships.

The other successful IJN submarine attack in the Western Carolines occurred on July 30, 1945. IJN I-58, a B3-class submarine commanded by Cmdr. Mochitsura Hashimoto, torpedoed and sank USS *Indianapolis* (CA 35) west of Guam and Ulithi on its way to the Philippines after having delivered components of Little Boy, the nuclear bomb later dropped on Hiroshima.⁷

IJN submarines scored their share of victories against U.S. warships, sinking two aircraft carriers (*Wasp*, *Yorktown*), a carrier escort (*Liscome Bay*), a light cruiser (*Juneau*),



Kaiten Technical information

The "Kaiten" manned torpedo was a modified Type 93 Model 3 long lance torpedo. The torpedo had a 24" diameter, was 54 feet long and weighed 8 tons. A plug was inserted in the body for the pressurized cockpit. The torpedo had a 3,410 lb warhead. It was powered by a kerosene/oxygen engine and could reach 30 knots.

four destroyers (*Hammann*, *Henley*, *O'Brien*, *Porter*), and two submarines (*Corvina*, *Grunion*) in the first two years of the war. They were not as successful later, however, because of the increasing effectiveness of U.S. ASW operations. Between September 25 and November 19, 1944, Japan lost submarines I-37, I-175, I-177, and I-364 in the Western Carolines to USN surface ships. Another factor that accounted for the IJN's poor submarine performance was overly cautious skippers who declined to attack unless conditions were highly in their favor.

In the Wake

In the Pacific theater, the USN had 51 submarines at the start of the war, lost 48, and had 153 remaining at war's end. The IJN started the war with 63 ocean-going submarines, lost 118, and had 46 remaining at war's end.

By the end of the war, USN submarines had accounted for more than 50 percent of IJN losses. The U.S. Submarine Force sank 1,178 merchant ships weighing 5,053,491 tons and 214 warships, including aircraft carriers, battleships, cruisers, destroyers, escorts, and submarines. By tonnage, only about 1 percent of these submarine successes were achieved in the Western Carolines.

Unfortunately, USN submarines' contributions during the two major U.S. actions in the Western Carolines—the airstrike in late March 1944 and the invasion of Peleliu and Angaur in September 1944—were minimal. Over the objection of Vice Adm. Charles Lockwood, SUBSOWESPAC, Adm. Chester Nimitz, Commander in Chief, Pacific Ocean

Areas, had ordered USN submarines to conduct operations in support of these actions that did not put them to their best use: eliminating IJN freighters, tankers, and transports.

Aside from their support in Operations DESECRATE ONE and STALEMATE II, U.S. submarines operating in the Western Caroline Islands relentlessly whittled down Japanese merchant shipping along their primary convoy routes east of the Philippine Islands. Following Operation STALEMATE II in fall 1944, the Japanese had to confine all of their merchant shipping to the East China Sea and the South China Sea. All IJN targets east of the Philippines had been eliminated, so U.S. submarines were shifted to patrolling farther west and north to prevent Japanese reinforcements and supplies from reaching the Philippines ahead of the invasion by U.S. forces under Gen. MacArthur.

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End Notes

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SUSTAINING THE TRIAD: The Enduring Requirements of Deterrence

Recently in Kings Bay, Ga., Navy leaders met with Air Force, government, community, and industry leaders at the undersea warfare conference “Sustaining the Triad: the Enduring Requirements of Deterrence” to discuss the future of U.S. strategic forces.

The conference provided an unclassified forum for policymakers and experts to continue the national narrative on the future of our nation’s nuclear deterrence, with a primary focus on the sea-based leg of the triad. This discussion was essential given that the nation is entering a critical time period for developing our follow-on Sea Based Strategic Deterrence (SBSD) – the Ohio Replacement Program.

In addition to having key Navy sea-based strategic deterrence stakeholders in attendance, this event was unique in that it featured many non-Navy speakers, including U.S. Representative Joe Courtney from Connecticut and Air Force Gen. C. Robert “Bob” Kehler, the recently relieved commander of United States Strategic Command, who spoke about the value of sea-based strategic deterrence. As Gen. Kehler said, “The SSBN force represents the most survivable leg of the triad. SSBNs that are underway in the Atlantic and Pacific Oceans remain undetected and increasingly comprise the largest concentration of our deployed warheads.”

The conference featured engaging discussion that furthered the dialogue on strategic deterrence.



Gen. C. Robert “Bob” Kehler

The Future of the U.S. Nuclear Deterrence Triad

The Second Nuclear Age—The future international nuclear environment is likely to be more stressing than today. Although the Cold War is over and the threat posed by the Soviet Union is in the past, we in the United States still must secure ourselves and more than two dozen of our friends and allies from both nuclear attack and nuclear blackmail. Nations with weak or non-existent democratic traditions such as Russia, China, and North Korea hold us and our allies at risk of catastrophic nuclear attack. Iran is threatening to join this group of potentially hostile competitors. There is no realistic chance that any of these nations will voluntarily abandon their nuclear capabilities—indeed, each is aggressively modernizing its forces. They are in for the long haul.

Nuclear deterrence is about the “non-use” of nuclear weapons—Nuclear deterrence is about influencing the decision not to

use nuclear weapons or deterring coercion through the threat to use nuclear weapons. Consistent with the past, the 2010 Nuclear Posture Review reaffirmed that our “nuclear forces will continue to play an essential role in deterring potential adversaries and reassuring allies and partners around the world.”

However, the role of deterrence as a matter of national policy is often viewed only through the lens of the bi-polar world of the Cold War. As such, the continued existence of our nuclear forces is considered by many as a Cold War anachronism that is not relevant today. Terms such as “apocalypse,” “Armageddon,” “push the button,” and others are often bandied about that focus on deterrence failure, as if it is a certain thing, while the historical reality is the opposite.

The kind of thinking that focuses on nuclear warfighting completely misunderstands the role of our nuclear forces. These forces do not exist to “push the button”—they exist to prevent the button from being pushed. The purpose of our nuclear arsenal is not war, but deterrence; that is to say,

dissuading any potential adversary from using or threatening to use nuclear weapons against us, our friends, and allies.

The Need for Conservatism and Caution in Assessing Deterrence Margins

Deterrence is a matter of perceptions. It takes place in the head of an adversary who lives in another country, has different values, is under different pressures, and has different goals. We can tell, for the most part, what makes deterrence stronger or weaker, but we can’t really put a number on it. This means that, if we want effective deterrence, we need to include in our analysis generous safety margins to account for the degree of uncertainty that is inherently present in every aspect of deterrence strategy.

Because deterrence is subjective, it must be communicated clearly. If we want effective deterrence, we had better deal with bold colors, a large font, and single-syllable words. Subtle and nuanced deterrence messages have a long history of being misunderstood.

Also, deterrence takes place in the con-

text of past behavior. Each event is not an isolated occurrence. Situations are understood in light of what has gone before. “Red lines” have to mean something. Promising action and then not delivering undermines credibility and may lead to misunderstood communications in later cases.

In today’s fiscal climate, the push in defense planning is to cut all “waste,” and for many that means shaving our nuclear deterrent to no more than exactly what is necessary. Treating deterrence matters as a precise science is dangerous and ignores the importance of other players, which is where deterrence really takes place.

Nuclear deterrence happens in the minds of those on the “other side”—Deterrence is about impacting the adversary’s decision-making, not ours. This sounds simple, yet it is easy to forget in practice. Effective deterrence is a multi-player game, even more so today in our multi-polar world than it was in the Cold War. A successful approach depends on what the other players do, in a manner similar to a chess match. The discriminating characteristic of a game of strategy like chess is that each player’s best approach is a function of what the other players do. We can’t devise our strategy in isolation. Imagine playing chess by choosing all of our moves in advance.

As we think about what investments are necessary for our own strategic future, we must be mindful that there are other players in the world, and we must adapt our approach to their existence and behavior—of both our friends and our potential adversaries.

Trends: Almost All in the Wrong Direction

In the years immediately after the Cold War, the popular optimism was that liberal democracy, capitalism, and peace were irreversibly going to spread around the world. A global moratorium on nuclear testing was emerging. Russia was being liberalized by President Boris Yeltsin. The North Koreans and the Pakistanis did not have the bomb. India had only conducted one test in 1974. The attacks of September 11, 2001 (9/11) had not yet taken place.

In the 1994 Nuclear Posture Review, the United States formally adopted a “lead but hedge” strategy. The United States would take the initiative in nuclear cuts in the hope

that others would be inspired to follow. The United States already had unilaterally shut down its weapon-production facilities and removed nukes from surface ships, ground forces, and aircraft-carrier aviation. We stopped enhancing our nuclear-weapon capabilities. We reduced our SSBN force from 18 to 14 *Ohio*-class submarines. However, we still reaffirmed the need to retain the three legs of our Nuclear Triad composed of bombers, intercontinental ballistic missiles (ICBMs), and SSBNs.

The world did not follow the path we hoped for in those heady days. Russia under Putin is now considered one of the most repressive areas on the globe, 9/11 occurred, and radical Islam is moving from being a “non-state actor” into the “nation-state” category. India and Pakistan have had several crises and “exchanged” nuclear tests in 1998. The Chinese economy has gone from eighth largest to second largest in the world, and China is growing its nuclear arsenal, unrestricted by any treaty and without the slightest transparency. North Korea withdrew from the Non-Proliferation Treaty, tested three nuclear devices, and declared its intent to expand its nuclear arsenal. And, of course, there is Iran.

In virtually every major category, the world’s nuclear trajectory is less benign than it was only 20 years ago. With the important exceptions of a series of nuclear-force reduction treaties between the United States and Russia and the increased security of former Soviet nuclear forces as a result of the Nunn-Lugar Cooperative Threat-Reduction Program, the changes have almost all been in the wrong direction.

The conclusion is inescapable—Virtually every long-term trend suggests that the future international nuclear environment will be more stressing than it is today, not less.

Realism Requires that We Acknowledge the Need to Retain Our Triad—It is clear that the United States will face nuclear-capable adversaries for the foreseeable future. It is equally clear that U.S. allies will remain exposed to the threat of nuclear attack or nuclear coercion requiring the protection provided by the U.S. nuclear umbrella. Taken together, these considerations make it evident that we in the United States must recapitalize our nuclear deterrent—including all three legs of the nuclear Triad.

The US/UK partnership under the Polaris Sale Agreement will continue with the U.S. Ohio Replacement and UK Successor SSBN



US *Ohio*-class Missile Compartment



UK Vanguard-class Missile Compartment

Cost-Effectiveness of the U.S. Nuclear Deterrent

Avoidance of Large-Scale Great Power Warfare—The most important way to think about the value of our nuclear deterrent is to realize the dramatic way it has fundamentally reduced the level of violence among great powers. Since World War II, great powers have not engaged in large-scale conflict, and there can be little question that the looming risk of escalation to nuclear weapons has played an important role in this change from past history. The savings in lives and dollars has been incalculable.

Small Share of Defense Budget and Gross Domestic Product—Nuclear weapons systems are expensive, and they represent a major investment by the American people. But their cost needs to be considered in comparison to both the nation's wealth and the important role that nuclear deterrence plays in conflict avoidance, U.S. security, and allied security. For example, the annual maintenance and operation of our nuclear forces today consumes about 4 cents of every 10 dollars we produce as a country each year. Even when recapitalization costs are figured in, the cost is low. To build, man, and operate the full complement of 12 new SSBNs for their full 42-year service lives will cost \$180 billion (in constant 2005 dollars). This is a lot of money, but it is less than 1 percent of what defense spending will be over those same 42 years.

Unprecedented Endurance and Cost-Efficiency—Each of the legs of the nuclear



The Ohio-class ballistic missile submarine USS Tennessee (SSBN 734) departs Naval Submarine Base Kings Bay.

triad represents a critical piece of U.S. national security infrastructure, and maximum cost-efficiency has been pursued and achieved by operating these systems at a high tempo for an unprecedented number of years. Our allies and adversaries have all had to replace their corresponding systems, but ours continue to operate reliably, and we will be able to depend on them for years to come. Careful management of engineering margins has enabled this long service life for all three of our triad legs, delaying the need for replacements and saving the country literally tens of billions of dollars.

Replacement Can No Longer Be Deferred—Engineering margins can only be pushed so far before we eventually start to see reliability degradations. By careful analysis, we can foresee when those reliability degradations will reach

a degree that cannot be accepted in nuclear weapons systems. We can see the time ahead when replacement is required. We have pushed it off as far as it can go.

Summary

We must be realistic and understand the critical role that nuclear weapons play in deterring aggression and coercion by authoritarian states against the United States and our friends and allies. It isn't a pleasant thing to think about, but it is an unavoidable truth that there are bad actors in the world who will only respond to a strong deterrent posture. As the most survivable leg of the triad, SBSD has been the guarantor of a strong response.

Fifty years of success have allowed SBSD to evolve into a lean, optimized force. There is no further room to compromise on capability or force size and still provide required capability to the Combatant Commander. Ohio Replacement costs are well understood, and the Navy takes its fiscal responsibility to the taxpayer seriously; we are aggressively pursuing ways to reduce costs while ensuring delivery of a capable platform to the nation that will last to the end of the century. The US-UK cooperation on the Common Missile Compartment (CMC) builds on 50 years of success. On-time delivery of the CMC by the United States is critical to the UK's ability to deliver its Successor-class SSBN on time and maintain a continuous at-sea deterrence presence.

A generation of Americans has benefited from the investments of the previous generation in nuclear deterrence. Now, as the world's most affluent nation, we need to have the national will to preserve the credibility of our strategic nuclear deterrence—the ultimate safeguard of global security.

The Strength of the Triad—Complimentary Capabilities

Although the Cold War is over, the basic lessons of effective nuclear deterrence remain in effect. The three legs of our triad each provide unique strengths that complement one another. It is no accident that all of the major nuclear powers have adopted the triad. Under the New START Treaty, although we have agreed to a smaller force, it is one that retains the strengths of the triad (both for us and for the Russians).

- **ICBMs:** Our ICBMs provide a unique contribution to stability. There is no cheap way to defeat the ICBM force—only a massive attack with high-quality nuclear weapons could seriously compromise ICBM force effectiveness. ICBMs also provide the President with rapid response capability should he require it.
- **SSBNs:** Our SSBN force provides the nation with a survivable second-strike capability. This provides assurance that no adversary can attack us and escape a devastating response. SSBNs also provide a unique and proven ability to change their operating areas and postures to reflect changes in the global geostrategic situation and the threat.
- **Bombers:** Bombers provide a degree of flexibility not available to missile forces. As we all saw in the spring of 2013, our bombers provide a unique ability to signal resolve in a way that is clearly evident to friend and foe alike. Images of American B2 bombers flying over Korea were carried as the lead story in virtually every major news organization in the world, demonstrating both our capability and our will.

Change of Command

COMSUBRON 1
Capt. Harry L. Ganteaume relieved
Capt. James C. Childs

COMSUBGRU 10
Rear Adm. Charles Richard relieved
Rear Adm. Joseph Tofalo

Naval Submarine Support Center,
Kings Bay
Cmdr. Chuck Cohn relieved
Cmdr. Greg McRae

USS *Chicago* (SSN 721)
Cmdr. Lance Thompson relieved
Cmdr. Nicholas Tilbrook

USS *Jefferson City* (SSN 759)
Cmdr. John Croghan relieved
Cmdr. Brien Dickson

USS *Key West* (SSN 722)
Cmdr. John Thompson relieved
Capt. Mark Benjamin

USS *Maine* (G) (SSBN 741)
Cmdr. Dale Klein relieved
Cmdr. Richard Massie

USS *Michigan* (SSGN 727) (G)
Capt. Benjamin Pearson relieved
Capt. Robert James

USS *Nebraska* (SSBN 739) (Gr)
Capt. Jeffrey Joseph (G) assumed full
command of Green crew from
Cmdr. Jason Wartell (B)

USS *Oklahoma City* (SSN 723)
Cmdr. Michael Ray Connor relieved
Cmdr. Andrew Peterson

USS *Olympia* (SSN 717)
Cmdr. Thomas H. Shugart III relieved
Cmdr. Michael J. Boone

USS *Emory S. Land* (AS 39)
Capt. Edward L. Herrington relieved
Capt. Glenn W. Pendrick

Qualified for Command

Lt. Clinton Christofk
COMSUBRON 11

Lt. Joseph Fontenet
COMSUBRON 1

Lt. William Fry
USS *Providence* (SSN 719)

Lt. Rooney Grogan
COMSUBRON 17

Lt. Cmdr. Ryan Heineman
COMSUBRON 11

Lt. Cmdr. Justin Hoff
COMSUBRON 1

Lt. Cmdr. Eric Hunter
COMSUBRON 17

Lt. Shawn Kiernan
USS *Florida* (SSGN 728) (G)

Lt. Kyle Kobold
COMSUBRON 17

Lt. Cmdr. Michael Kos
COMSUBRON 7

Lt. Nicholas Lancaster
COMSUBRON 19

Lt. Cmdr. Alan Mardegian
USS *Tennessee* (SSBN 734) (B)

Lt. Jason Whiteman
USS *Georgia* (SSGN 729) (G)

Lt. Cmdr. Alexander Voeller
USS *Boise* (SSN 764)

Qualified in Submarines

Lt. j.g. Justin Bardin
USS *Nevada* (SSBN 733) (G)

Lt. j.g. Joshua Bone
USS *Connecticut* (SSN 22)

Lt. j.g. Scotlin Bowden
USS *Norfolk* (SSN 714)

Lt. j.g. Jeremy Bricco
USS *Minnesota* (SSN 783)

Lt. j.g. Brett Campbell
USS *Boise* (SSN 764)

Lt. j.g. Geoffrey Campbell
USS *San Juan* (SSN 751)

Lt. j.g. Marcus Cline
USS *Jacksonville* (SSN 699)

Lt. j.g. Alexander Corpuz
USS *Maryland* (SSBN 738)

Lt. j.g. Kristopher Curtis
USS *Olympia* (SSN 717)

Lt. j.g. Ian De Soto
USS *Scranton* (SSN 756)

Lt. j.g. Christopher Del Vecchio
USS *Albany* (SSN 753)

Lt. j.g. Dean Dorbransky
USS *Olympia* (SSN 717)

Lt. j.g. Michael Strom Eyer
USS *San Juan* (SSN 751)

Lt. Daniel Faherty
USS *Scranton* (SSN 756)

Lt. j.g. Daniel Farrar
USS *Minnesota* (SSN 783)

Lt. j.g. Neal Greenlund
USS *Toledo* (SSN 769)

Lt. j.g. Andrew Hardy
USS *Helena* (SSN 725)

Lt. j.g. Thomas Harris
USS *Nevada* (SSBN 733) (G)

Lt. j.g. Michael Head
USS *Minnesota* (SSN 783)

Lt. j.g. Christopher Kopp
USS *San Francisco* (SSN 711)

Lt. j.g. Andrew Kramer
USS *Charlotte* (SSN 766)

Lt. j.g. Benjamin Krawczvk
USS *Nevada* (SSBN 733) (G)

Lt. Jason Lovell
USS *Alexandria* (SSN 757)

Lt. j.g. Christopher Lyons
USS *Providence* (SSN 719)

Lt. j.g. Thomas Magnuson
USS *Virginia* (SSN 774)

Lt. j.g. Jeffrey McCormick
USS *Georgia* (SSGN 729) (B)

Lt. j.g. Karl Meyer
USS *Columbus* (SSN 762)

Lt. j.g. David Nershi
USS *Connecticut* (SSN 22)

Lt. j.g. James Nevins
USS *Helena* (SSN 725)

Lt. j.g. Ward Ooenwald
USS *Scranton* (SSN 756)

Lt. j.g. Jason Papale
USS *Columbia* (SSN 771)

Lt. j.g. Zachary Prefontaine
USS *San Juan* (SSN 751)

Lt. j.g. Christopher Pope
USS *Jacksonville* (SSN 699)

Lt. j.g. Charles Robinson
USS *Santa Fe* (SSN 763)

Lt. j.g. Jon Michael Rosenbaum
USS *Providence* (SSN 719)

Lt. j.g. Rachael Sakurai
USS *Ohio* (SSGN 726) (B)

Lt. j.g. Emil Scown
USS *Nevada* (SSBN 733) (G)

Lt. j.g. Taylor Shope
USS *Minnesota* (SSN 783)

Lt. j.g. David Steinberger
USS *Columbia* (SSN 771)

Lt. j.g. Jason Ulbrich
USS *Columbia* (SSN 771)

Lt. Bradley Ullis
USS *Scranton* (SSN 756)

Lt. j.g. Jacob Webb
USS *Pittsburgh* (SSN 720)

Lt. j.g. Jeremiah Weerheim
USS *Georgia* (SSGN 729) (B)

Lt. Sean Weinmann
USS *Asheville* (SSN 758)

Lt. j.g. Nathan Whitelaw
USS *Scranton* (SSN 758)

Lt. j.g. Timothy F. Whitney
USS *Pittsburgh* (SSN 758)

Lt. j.g. Oliver Zufelt
USS *Alexandria* (SSN 757)

Qualified Nuclear Engineering Officer

Lt. j.g. Michael Adcock
USS *Rhode Island* (SSBN 740) (G)

Lt. Santiago Alvarez
USS *Key West* (SSN 722)

Lt. j.g. William Ballou
USS *Jimmy Carter* (SSN 23)

Lt. j.g. Luke Barousse
USS *Jimmy Carter* (SSN 23)

Lt. j.g. Brian Beard
USS *Albuquerque* (SSN 706)

Lt. j.g. Kyle Behbehani
USS *Nebraska* (SSBN 739) (B)

Lt. j.g. Alexander Berta
USS *Nebraska* (SSBN 739) (B)

Lt. Nikola Blagojevic
USS *Topeka* (SSN 754)

Lt. j.g. Evan Borland
USS *Pennsylvania* (SSBN 735) (B)

Lt. Owen Brooks
USS *Key West* (SSN 722)

Lt. j.g. Ronald Bucciero
USS *Florida* (SSGN 728) (B)

Lt. j.g. Mark Buonomo
USS *Alaska* (SSBN 732) (G)

Lt. j.g. Matthew Burchill
USS *La Jolla* (SSN 701)

Lt. Robert Carelli
USS *City of Corpus Christi* (SSN 705)

Lt. j.g. Patrick Cavazos
USS *San Francisco* (SSN 711)

Lt. Andrew Chaloupka
USS *Rhode Island* (SSBN 740) (B)

Lt. j.g. Bryan Chapman
USS *Mississippi* (SSN 782)

Lt. j.g. Jacob Coultre
USS *Bremerton* (SSN 698)

Lt. j.g. Adam Dambra
USS *Helena* (SSN 725)

Lt. j.g. Christopher Del Vecchio
USS *Albany* (SSN 753)

Lt. Jeffrey Denzel
USS *Olympia* (SSN 717)

Lt. j.g. Brendan Dougherty
USS *San Juan* (SSN 751)

Lt. Alexander Duffy
USS *Bremerton* (SSN 698)

Lt. j.g. Matthew Duffey
USS *Michigan* (SSGN 727) (B)

Lt. j.g. John Dugger
USS *California* (SSN 781)

Lt. j.g. Alexander Dworjan
USS *Columbus* (SSN 762)

Lt. Vanessa Esch
USS *Ohio* (SSGN 726) (B)

Lt. j.g. Matthew Gautreau
USS *Georgia* (SSGN 729) (G)

Lt. j.g. Coleman Gonzalez
USS *Buffalo* (SSN 715)

Lt. j.g. Jack Hatcher
USS *Wyoming* (SSBN 742) (B)

Lt. j.g. Clinton Hillman
USS *Rhode Island* (SSBN 740) (B)

Lt. j.g. Michael Hogan
USS *Jacksonville* (SSN 699)

Lt. William Howard
USS *Cheyenne* (SSN 773)

Lt. Joseph Hubley
USS *Key West* (SSN 722)

Lt. Alexander Kelley
USS *New Mexico* (SSN 779)

Lt. j.g. Daniel Kemp
USS *Florida* (SSGN 728) (G)

Lt. Andrew Kerr
USS *Georgia* (SSGN 729) (G)

Lt. j.g. Brian Kirk
USS *Louisville* (SSN 724)

Lt. j.g. Joshua Kirlin
USS *Key West* (SSN 722)

Lt. j.g. Matthew Knepper
USS *Alaska* (SSBN 732) (G)

Lt. j.g. Nicholas Laine
USS *Michigan* (SSGN 727) (B)

Lt. j.g. James Ley
USS *Greeneville* (SSN 772)

Lt. j.g. Michael Lopez
USS *Maine* (SSBN 741) (B)

Lt. Matthew Main
USS *New Mexico* (SSN 779)

Lt. j.g. Christopher Marolt
USS *Asheville* (SSN 758)

Lt. j.g. David Martin
USS *Tucson* (SSN 770)

Lt. j.g. Jonmichael McCartney
USS *Connecticut* (SSN 22)

Lt. j.g. Aaron Mckeen
USS *Florida* (SSGN 728) (G)

Lt. Eric Peters
USS *Albuquerque* (SSN 706)

Lt. Ryan Peterson
USS *Chicago* (SSN 721)

Lt. j.g. Paul Piavis
USS *Louisiana* (SSBN 743) (B)

Lt. j.g. Karl Plank
USS *Florida* (SSGN 728) (G)

Lt. j.g. Andrew Post
USS *Jefferson City* (SSN 759)

Lt. Brendan Rice
USS *Annapolis* (SSN 760)

Lt. j.g. Mathew Rockwell
USS *Pittsburgh* (SSN 720)

Lt. j.g. Kimberly Roe
USS *Georgia* (SSGN 729) (G)

Lt. j.g. Benjamin Sandman
USS *New Hampshire* (SSN 778)

Lt. j.g. Adam Schaefer
USS *Hartford* (SSN 768)

Lt. j.g. John Schaeffer
USS *Maine* (SSBN 741) (B)

Lt. j.g. Michael Schambach
USS *Maryland* (SSBN 738) (G)

Lt. j.g. Joseph Sheffield
USS *Springfield* (SSN 761)

Lt. j.g. Steven Sideri
USS *Hartford* (SSN 768)

Lt. John Sison
USS *Virginia* (SSN 774)

Lt. Tucker Stachitas
USS *Jimmy Carter* (SSN 23)

Lt. Adam Stanton
USS *Nebraska* (SSBN 739) (B)

Lt. j.g. John Ulett
USS *Newport News* (SSN 750)

Lt. Peter Vanvliet
USS *Annapolis* (SSN 760)

Lt. j.g. Andrew Weiner
USS *Maryland* (SSBN 738) (B)

Lt. j.g. Jeffrey Withington
USS *Hartford* (SSN 768)

Lt. Marshall Witkowski
USS *North Carolina* (SSN 777)

Engineering Department Master Chief

EMC Eric Armbrister
USS *Rhode Island* (SSBN 740) (B)

EMC Matthew Bailey
USS *Ohio* (SSGN 726) (G)

MMC Darrin Bostater
USS *Florida* (SSGN 728) (B)

MMC Justin Buckman
USS *Henry M. Jackson* (SSBN 730) (B)

EMC Thomas Catsigris
USS *Jimmy Carter* (SSN 23)

EMC David Chechile
USS *Montpelier* (SSN 765)

EMC Nicholas Clemons
USS *Henry M. Jackson* (SSBN 730) (B)

ETC Evan Davis
USS *North Dakota* (SSN 784)

ETC Daniel Denault
USS *Alabama* (SSBN 731) (G)

MMC Jason Dillehay
Naval Submarine Support Center
(NSSC) Kings Bay

MMC Andrew Dostal
USS *Florida* (SSGN 728) (G)

EMC Michael Edwards
NSTCPAC

ETC Stephen Geis
USS *Montpelier* (SSN 765)

MMC Robert Gilkerson
CSP Rep, PSNS

ETC Raymond Gomez
NRD Phoenix

EMC Nathan Gottsch
USS *Charlotte* (SSN 766)

MMC Michael Griffith
USS *Nebraska* (SSBN 739) (B)

MMC Dominick Grimaldi
USS *Ohio* (SSGN 726) (B)

MMC Sterling Guyton
NRMD New London

MMC Todd Hatch
USS *Tucson* (SSN 770)

MMC Jason Hays
USS *Topeka* (SSN 754)

EMCS Shayne Hicks
COMSUBRON 19

MMC Paul Jackson
USS *Alaska* (SSBN 732) (B)

ETC Christopher Lawrence
USS *Charlotte* (SSN 766)

EMC Tony Layher
USS *North Dakota* (SSN 784)

EMC Harry Leiser
USS *Wyoming* (SSBN 742) (B)

ETC Thomas Marsland
USS *Georgia* (SSGN 729) (B)

ETC Bradley May
USS *Pennsylvania* (SSBN 735) (B)

MMC David Medert
USS *New Mexico* (SSN 779)

MMC Jeffrey Mejia
USS *Columbia* (SSN 771)

MMC Jesse Miller
NRMD PT LOMA

MMC Michael Mrsny
USS *San Francisco* (SSN 711)

MMC James Oxendine
USS *Henry M. Jackson* (SSBN 730) (G)

MMC Dustin Palmer
COMSUBRON 1

EMC Delbert Parrish
USS *Nevada* (SSBN 733) (G)

MMCS Ryan Parsons
USS *Albuquerque* (SSN 706)

MMCS Jeffrey Picerno Jr.
USS *Toledo* (SSN 769)

EMC Donte Polson
USS *Connecticut* (SSN 22)

EMC Michael Quackenbush
USS *Providence* (SSN 719)

EMC Travis Radzysinski
USS *Newport News* (SSN 750)

EMC Jesse Rayburn
USS *San Francisco* (SSN 711)

EMC Michael Reuss
USS *North Carolina* (SSN 777)

MMC Brent Roets
USS *Greeneville* (SSN 772)

ETC Robert Rupert
USS *Providence* (SSN 719)

EMC Eric Schulte
USS *Springfield* (SSN 761)

MMC Benjamin Schulz
USS *North Dakota* (SSN 784)

EMC Michael Sims
USS *Oklahoma City* (SSN 723)

ETC Randy Sparks
USS *Hampton* (SSN 767)

ETC Dustin Spicer
USS *Alabama* (SSBN 731) (B)

ETC Jonathan Stephens
USS *New Mexico* (SSN 779)

EMC Mark Steward
USS *Louisiana* (SSBN 743) (B)

ETC Luis Torres
USS *Scranton* (SSN 756)

ETC Terrance Tyson
USS *Wyoming* (SSBN 742) (B)

MMC Jason Vangorden
USS *Michigan* (SSGN 727) (B)

Supply Officer Qualified in Submarines

Lt. j.g. Brandon Grey
USS *Nevada* (SSBN 733) (G)

Ens. Michael Marchese
USS *Annapolis* (SSN 760)

Ens. Jason Potvin
USS *Boise* (SSN 764)

Qualified Surface Warfare Officer

Ens. Michael F. Peoples
USS *Frank Cable* (AS 40)

Qualified Surface Warfare Medical Diving Officer

Lt. David Burke
USS *Frank Cable* (AS 40)

Cmdr. Harold Zald
USS *Frank Cable* (AS 40)



2nd Place: Aimee Steimer—“First Wave to Daddy”



1st Place: Cmdr. Mike Quan—
“Providence Teamwork on Deployment”



THE 15TH ANNUAL Photo Contest Winners

Each year, the Naval Submarine League (NSL) and *UNDERSEA WARFARE* Magazine team up to sponsor a photo contest. We congratulate the winners and thank all those who participated in this year’s contest.



Honorable Mention: Branden Lee—
“The USS *Bowfin* in Pearl Harbor”



3rd Place: MC2 Steven Khor—
“Aloha and Goodbye”



Submarine Museums and Memorials



USS *Cod* (SS 224) Cleveland, Ohio

U.S.S. *Cod* (SS 224), is a World War II-era *Gato*-class fleet submarine that began her life on July 21, 1942 when her keel was laid at the Electric Boat Co., Groton, Connecticut. *Cod* was launched on March 21, 1943 under the sponsorship of Mrs. Grace M. Mahoney, wife of a veteran shipyard employee.

Cod is credited with sinking more than 12 enemy vessels, totaling more than 37,000 tons, and damaging another 36,000 tons of enemy shipping. All seven of her war patrols were considered successful and *Cod* was awarded seven battle stars.

On May 10, 1944, during *Cod*'s third patrol, the boat maneuvered into firing position just after sunrise and fired three of her four stern tubes at the Japanese destroyer *Karukaya* and then unloaded all six of her bow tubes at two columns of cargo ships and troop transports. The first torpedo exploded under the destroyer's bridge causing both smoke stacks to collapse and dozens of enemy sailors to be tossed in the air. The enemy ship started to sag in the middle, with bow and stern rising, just as the second torpedo hit near the main mast causing the whole rear half of the *Karukaya* to disintegrate.

A minute later, all six of *Cod*'s bow shots hit targets among the columns of enemy ships. Between the explosions of the enemy depth charges, *Cod*'s sonar operators could hear the sounds of several Japanese ships breaking up and the distinct firecracker sound of an ammunition ship's cargo exploding.

Notably, over the course of seven successful war patrols, *Cod* lost just one man. During her sixth patrol, on April 26, 1945 S1c Andrew Gordon Johnson drowned after being washed overboard while assisting in topside casualty control actions for a fire in the aft torpedo room.

On *Cod*'s seventh and final war patrol she performed the only international submarine-to-submarine rescue in history. On the morning of July 8, 1945 *Cod* arrived at Ladd reef in the South China Sea to aid the Dutch submarine *O-19* which had grounded on a coral outcropping. After two days of trying to free the Dutch boat from the reef *Cod* removed the 56 sailors and destroyed *O-19*. The *Cod* was home to 153 men for the two and a half day run to Subic Bay naval base.

Twice decommissioned and placed in reserve, *Cod* was eventually recommissioned in 1959 and served as a training ship for 12 years in Cleveland, Ohio. After her final inactivation in 1971, a handful of Clevelanders formed the Cleveland Coordinating Committee to Save *Cod*, Inc., to preserve her as a memorial on the city's lakefront, and in January, 1976, the Navy gave guardianship of the submarine to the group. *Cod* is now docked in Lake Erie at Cleveland, Ohio and is maintained and operated as a memorial to the more than 3,900 submariners who lost their lives during the 100 year history of the United States Navy Submarine Force. On the shore beside the submarine are a Mark 14 steam-driven torpedo, a five-bladed propeller of the kind installed on *Cod* and a vintage 1950s periscope.