THE SUBMARINE REVIEW

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EDITOR'S COMMENTS

The lead Feature in this issue of **THE SUBMARINE REVIEW** is Admiral Hank Chile's progress report on the state of preparations for the Submarine Centennial Celebration to be held two years from now throughout the country. As part of the run-up to the Year 2000 festivities (and the 2001 Centennial in Great Britain) this magazine will be presenting a series of articles on the early days of submarining, including both the events leading to John Holland's successful sale to the U.S. Navy and the immediately subsequent efforts in technical improvement and tactical innovation.

As with the history of military aircraft, it is also appropriate to remember the great contributions of inventors, engineers and experimenters in other lands to our beginnings. We are planning several articles on the French, Swedish, German and Russian efforts. It is particularly important to review the French submarine purposes and history immediately prior to the start of this century because their country, as opposed to the U.S. and Great Britain, early recognized the significance of undersea warfare and had a national program for the development of submarines.

One of the more interesting aspects of the early history of U.S. submarining is the rather intense test and sea trial program carried out by John Holland in New York Harbor, one of the busiest waterways in the world. This is treated in this issue by Colonel Sinnott in his characterization of New York Harbor in terms of being the same kind of cradle for development of the submarine as Dayton, Ohio was for aircraft.

The April issue in the year 2000, just two short years from now, will be devoted exclusively to the Submarine Centennial. At that point we, as a community, will be looking back over the Twentieth Century to emphasize the lessons we have learned which will guide us into the Twenty First Century. In a group such as ours, with no lack of strong opinion on these matters, there are certain to be many suggestions for articles of interest and importance to the history and future of submarining. This is a first invitation to make known those concepts and desires so we can start work on what we hope to make a memorable publication event.

Among all branches of armed forces the wonderful world of nuclear submarines has a very unique problem when it comes to

disposing of our no-longer-usable primary platforms. The second Feature of this issue is an excerpt from a Navy publication which details the extent of attention, expertise, care and effort given to accomplishing that disposal in the most responsible manner.

Just to keep reminding us that we are a long way from knowing all there is to know about operating in the undersea world, and the technology which is needed to be successful there, the rather fascinating business of fulminate marine corrosion comes to our attention. Dr. Richard Rosenblatt has given us a most interesting introduction to the problem of archaea microbials vs. submarines. The Submarine Force is following this problem and the investigation of its implications.

There are many other subjects addressed in this issue and space will not permit an editorial comment on each; however, three of those subjects will be given some special mention. The concept of having two crews for attack submarines has generated a fair amount of attention and is treated further in both a Discussion article and a Letter. In addition, we are carrying an article by Commander Tom Belke on a subject of concern somewhat broader than an exclusively submarine interest. He explains the military culture of North Korea and portrays it as a potential and imminent threat to military stability in a part of the world now undergoing tremendous change and stress.

Lastly, the Book Review section makes note of a book highlighting the World War II accomplishments of Vice Admiral Arnie Schade. He is being honored this year at the League's Annual Symposium in June as the Submarine Hero of the Year. Although many of us remember Admiral Schade best as a very fine Commander of Submarines, Atlantic, we should not forget that he was the one who did "Take 'er Down".

Jim Hay

FROM THE PRESIDENT

As has been stated, and restated since 1985, we are in a period of rapidly declining resources for Defense. The Navy and the Submarine Force have been reduced drastically and an end to the down-trend is not readily obvious.

In line with the League's primary goal of educating our members, or at least making them aware of various issues and factors affecting the Submarine Force, we have discussed several studies over the last years. These studies have been directed by Congress, SecDef or SecNav and most have selectively impacted submarines.

A new (or latest) report was completed in December 1997. Entitled Transforming Defense—National Security in the 21st Century, it was directed by Congress in Section 924 of the Military Force Structure Act of 1996 and was completed by a National Defense Panel chaired by Philip Odeen.

It was too late to print the Executive Summary which I hope we can do in the next issue, but you should be aware of some specific discussions. In light of the above, the following two paragraphs are verbatim from the report. The theme of the report studies is: "Defense is but one element of a broader national security structure ... the entire U.S. national security structure must adapt and become more integrated, inherent and proactive."

This first paragraph is taken from the Introduction:

"If increased funding is not available, we can do one or some combination of the following:

- Mount a major effort to streamline support costs and infrastructure.
- Rethink today's defense posture with its focus on two regional conflicts.
- Develop new operational concepts to employ currently planned forces exploiting asymmetric advantages and reducing the number of required forces.
- Reduce readiness and manpower levels.
- Reduce Defense participation on peacekeeping and humanitarian activities.
- Cancel one or more major weapons systems and reorder service acquisition planes, accepting some increased near-term risk."

And this second paragraph, of most interest, is from the

chapter, "Force Capabilities" (specific examples of the *kind of actions* necessary...).

"Sea Forces

- Move toward small-signature ships capable of providing sustained long-range precision firepower;
- Design ship production to allow rapid incorporation of latest technology;
- Provide greater quantities of small UUVs to augment and extend the reach of submarines;
- Construct follow-on carriers to capitalize on short take-off, vertical landing; unmanned aerial vehicle; and unmanned combat aerial vehicle aircraft characteristics with attendant reduction in size and personnel;
- Consider sea-based mobile off-shore bases to provide access in situations where forward bases are unavailable or at-risk to prepositioned forces;
- Provide insertion vehicles incorporating the latest technologies to extend the reach of the maneuver component of the naval power projection forces."

In other thoughtful and thought-provoking sections, the report strongly endorses jointness and strengthening "Goldwater-Nichols; assessing the relevance of the 1947 National Security Act; "fundamental reform" of DoD's support infrastructure (including the PPBS system, and the Defense Reform Initiative to compete 150,000 positions across DoD and increasing it to 600,000 positions in commercially oriented support tasks.)

I honestly believe, if taken seriously, this report could have the same impact as those which led to the National Security Act of 1947 and DoD, CIA, the USAF et.al.

Finally, on a different note, there will have been a complete changing of the guard in the Submarine Force by the time of our June Symposium. ComSubLant will be VADM Ed Giambastiani; Rich Mies will have moved to Omaha as COMSTRATCOM and will be Admiral Mies; ComSubPac will be RADM Al Konetzni; RADM Jerry Ellis will be Oceanographer of the Navy; and RADM Mal Fages will be N87 (having been relieved by RADM John Padgett as ComSubGruTwo.

Our congratulations to each of them. Each has been and will continue to be strong supporters of the NSL.

Dan Cooper

2000—THE SUBMARINE CENTENNIAL

Status Report by
ADM Hank Chiles, USN(Ret.)
and CAPT Dave Cooper, USN(Ret.)

In the year 2000 the United States Submarine Force will celebrate its Centennial Anniversary. Since 1900, our submarines have evolved from small submersibles with limited capability to proven warfighters in World War II to nuclear powered, multi-mission warships. Nearly 100 years of technological innovation and flexible adaptation to changing strategic and defense needs have made today's Submarine Force ready and able to respond decisively across the spectrum of conflict. The United States Submarine Force, an acknowledged symbol of military excellence, is poised to enter its second century of undersea dominance with the most highly trained people and advanced platforms in history.

Such a track record and bright future deserves a first class commemoration to emphasize our theme: ***From the Depths: Seapower.***

To prepare for this celebration we were asked to bring together a national organization of members of the U.S. Submarine Veterans of World War II, the Naval Submarine League and the United States Submarine Veterans, Incorporated (USSVI) to assist the active duty Submarine Force in organizing and coordinating a countrywide event. Admiral Bill Crowe and Admiral Jim Watkins have agreed to be the Honorary Chairmen of our organization. To date, we've formed an Advisory Board led by former CNO, Admiral Carl Trost, with four committees as follows:

Committee	Chairman
Events and Exhibits	VADM Al Burkhalter
Memorabilia	VADM J.D. Williams
Publicity	RADM Hank McKinney
Fund-raising	Mr. Tom Corcoran

We won't name all of the former military personnel who have agreed to serve on the Advisory Board and these committees, but all three submarine organizations are well represented. Some of those who agreed to serve include: ADM Frank Kelso, ADM Bob

Long, Mr. Will Ball (former Secretary of the Navy), Mr. Larry Garrett (former Secretary of the Navy), Mrs. H.G. Rickover, Mrs. Susan Skelton (sponsor of USS JEFFERSON CITY), Dr. Bob Ballard, Mr. Jim Turner (President of General Dynamics), Dr. Vance Coffman (CEO of Lockheed Martin), Mr. Bill Fricks (President of Newport News Shipbuilding), Mr. John Welch (President of Electric Boat), Senator Joe Lieberman, Senator Jim Exon, Senator Dan Inouye, Senator John Chafee, Congressman Norm Dicks, Congressman Herb Bateman, Congressman Owen Pickett, Congressman Sam Gejdenson, VADM Gene Fluckey, CAPT Ned Beach, Mr. Jack Ensminger (Senior Vice Commander of the USSVI), and Mr. Jack Kennedy (President of the Navy League). Mr. Bob Fleet, Past President of U.S. SubVets of WWII, had been on the Board prior to his unfortunate death in an auto accident. His replacement is CAPT Art Rawson.

The Centennial will be countrywide to run from the first of January to the end of December 2000. The Events and Exhibits Committee is working to bring together a master plan for commemorative events and to coordinate activities. To date, no decisions have been made on specifics, but considerable planning is ongoing (for example, the SubVets of WWII are actively working to sponsor events at the Naval Training Center, Great Lakes). Undoubtedly, the Submarine Birthday Balls at various submarine home ports will be highlights. We have discussed lessons learned with personnel who planned the Air Force Fiftieth, Naval Aviation Seventy-fifth, and World War II commemorations. We have discussed publicity and coordination with the Navy League and expect to work closely with the Navy League in the namesake cities and states to ensure appropriate recognition and ceremonies. We are considering dedication of a week of the year to each of the submarines lost in WWII. We are investigating display of submarine memorabilia and educational mock-ups to highlight the submarine warfighting expertise and technology infusion to United States national capabilities, in national museums (such as the Smithsonian) and easily accessible facilities.

Our focus is to decide over the next six months what, where, and when we want events and exhibits to take place; what memorabilia we want; what publicity is necessary and to give the Fundraising Committee sufficient guidance to provide the assets needed.

As you may have heard, we are requesting that the U.S. Postal

service issue a submarine stamp or plate of stamps to honor the Submarine Force. Two prior requests to the Citizens' Stamp Advisory Committee have been rejected, including one signed by the Secretary of the Navy with a supporting letter by the Secretary of Defense, so we realize it's an uphill battle. A number of our members have written to the head of that committee (Dr. Virginia Noelke, Citizens' Stamp Advisory Committee, U.S. Postal Service, 475 L'Enfant Plaza, SW, Room 4474E, Washington, DC 20260-2437) to support our request both from the standpoint of a warfighting track record and our contributions to technology. We need stamp collectors and people who buy stamps to jump on the bandwagon. The Committee has agreed to reconsider our stamp proposal at their 23 April meeting.

A Secretary of the Navy Instruction has been signed designating the year 2000 to be the commemorative period for the Submarine Force Centennial and appointing the Director, Submarine Warfare Division (N87), as the coordinator.

We are interested in your ideas and have established an office at the Submarine League headquarters. Contact us there.■

PAT LEWIS MEMORIAL SCHOLARSHIP

The Dolphin Scholarship Foundation has chosen Abigail S. Bishop of 905 Rashford Drive, Placentia, CA 92870-4448 as the 1997 Pat Lewis Memorial Scholar. Abigail's father, Commander Stephen C. Bishop, USN(Ret.), served on active duty in the Submarine Force for nearly 10 years, then completed his service as a member of the Selected Reserves prior to his retirement in 1994. His final active duty command was on the OP-02 staff at the Pentagon.

Abigail is attending Wellesley College in Massachusetts, where she plans to earn her teaching degree and teach elementary school children. She is a musician and artist, with six years of piano and seven years of ballet experience. Abigail is an extremely bright student who graduated in the top 1 percent of her class of 332 from Troy High School in Fullerton, California, and earned a perfect score on the math portion of her SAT.

NUCLEAR SUBMARINE DISPOSAL AND RECYCLING

The following paper is an excerpt from the booklet U.S. Naval Nuclear Powered Submarine Inactivation, Disposal, and Recycling published in March of 1995 by the Sea Systems Command of the U.S. Navy. The information from that publication is reprinted in response to several requests for "the rest of the story" following Mr. Bill Galvani's article Mooring ALPHA—End of the Line in the October 1997 SUBMARINE REVIEW. Minor statistical revision has been done in updating the number of reactor compartments transported from Puget Sound Naval Shipyard to the Department of Energy's Hanford Site.

Navy ships are inactivated at the end of their useful lifetime when their military capability does not justify the cost of continued operation, or when necessary to comply with treaty requirements that limit ballistic missile capacity. When the decision is made to inactivate a nuclear powered submarine, it must be defueled, and appropriate actions must be taken to dispose of the reactor plant and the remainder of the submarine.

In the late 1970s the Navy recognized that a number of nuclear powered submarines would require inactivation and disposal in the coming years. In accordance with the National Environmental Policy Act, the Navy began evaluating alternatives for disposal. Two basic options were evaluated:

1. Disposal of the defueled reactor compartment (the section of the submarine containing the reactor plant) at an existing land burial site, with the non-radioactive remainder of the submarine disposed of either by sinking at-sea or by cutting up for sale as scrap metal; or
2. Disposal by sinking the entire defueled submarine in the deep ocean.

The Navy's 1984 Final Environmental Impact Statement found that either land or sea disposal of the reactor compartments would be environmentally safe and feasible. The Record of Decision issued by the Navy on December 6, 1984, concluded that "Based on consideration of all current factors bearing on a disposal action of this kind contemplated, the Navy has decided to proceed with disposal of the reactor compartments by land burial. As of April 1, 1998 the Navy has safely shipped 73 submarine reactor compart-

ments to the Department of Energy's disposal grounds at Hanford, Washington.

Initially, the forward and aft sections of the defueled and decommissioned submarines were rejoined and placed in floating storage following reactor compartment removal, while a permanent program was being developed to eliminate the remainder of the ship. In 1991 the Navy began to recycle these rejoined submarine sections. Currently, recycling these sections of the submarine is accomplished in parallel with the reactor compartment removal work. The recycling process removes and refurbishes components having value to the Navy and cuts apart the remainder of the submarine to allow segregation and recycling of metals and other materials of value.

The submarine disposal operations developed by the Navy do not involve any sophisticated technology, but use basic engineering principles and common industrial practices. From the outset, the major program goals were minimizing radiation exposure, meeting state and federal environmental and safety regulations, and controlling cost. The technology to perform submarine inactivation and recycling is straightforward and well within the capability of a large shipyard. It is basic disassembly, component removal, heavy lifting, packaging, and transporting, which are comparable to ship construction and repair activities. The most time consuming actions are those needed to meet regulatory requirements common to the disposal of all U.S. warships, such as removal of chemical residues from metal surfaces.

Submarine inactivation and disposal work employs the same safety and environmental controls that are used for work on nuclear powered ships undergoing overhaul. Work involving radioactivity, lead, asbestos, PCBs, or other hazardous materials, is accomplished by personnel trained to work with these materials. They are equipped with the proper personal protective equipment where needed, and the work is accomplished in areas that are controlled to prevent the spread of contaminants. Waste is controlled and disposed of in accordance with applicable state and federal regulations, using licensed transportation contractors and approved disposal sites.

The control of radiation exposure to shipyard workers is discussed in detail in the Navy's annual report NT-98-2 of February 1998. This report shows that the average occupational

exposure of each person monitored in the shipyard workforce is less than two-tenths of a rem per year. For comparison, the amount of radiation exposure a typical person in the United States receives each year from natural background radiation is three-tenths of a rem. Individual worker exposure is strictly controlled, resulting in exposures less than 50 percent of the federally established limit of 5 rem per year. In fact, no shipyard worker has exceeded 2 rem in any given year since 1979.

Inactivation

Submarines scheduled for inactivation have their weapons removed prior to arrival at the shipyard. Upon arrival, the submarine's reactor is shut down and the submarine is inactivated and defueled in a planned sequence. Expendable materials, technical manuals, tools, spare parts, and loose furnishings are removed, including items such as linen, kitchen supplies, and utensils. Classified/sensitive equipment and materials including the cryptographic facilities are removed. The main storage battery is removed from the submarine. Refrigerant and oxygen are offloaded. Piping for sea water, main steam, potable water, fuel oil, and other systems not needed for defueling operations are drained. Hydraulic systems are drained and flushed. Tanks containing fuel oil and other fluids are drained and cleaned. Sanitary systems are drained, cleaned, and disinfected. The submarine's electrical and lighting systems are de-energized and temporary ventilation, lighting, power, and compressed air services are installed.

With the ship in drydock, an opening is cut in the hull, interferences are removed, and a refueling enclosure is installed on the hull over the reactor to provide a controlled work area with filtered ventilation. Access is provided into the reactor and fuel is removed into a shielded transfer container which is then moved by crane to a dockside enclosure. The fuel is placed into a specially-designed shipping container. Defueling employs the same proven procedures and equipment that have been successfully used in over 300 naval rector refuelings and defuelings.

After defueling, preparations are made to facilitate reactor compartment removal. The pressure vessel, piping, tanks, and fluid system components that will remain with the reactor compartment are drained to the maximum extent practicable, while keeping

radiation exposure to workers as low as reasonably achievable. Absorbent is added to the accessible internal areas to fix in the absorbent residual liquid that may be present. The system draining procedures are effective in removing nearly all (over 98 percent) of the liquid originally present. Only a small amount of liquid remains trapped in discrete locations such as pockets in valves, pumps, tanks, vessels, and other inaccessible piping system components. All openings into radioactive systems are sealed. At this point the rector compartment is ready to be separated from the submarine and packaged for disposal.

Missile Compartment Dismantlement

In 1980, because of SALT II Treaty limits, the Navy began retiring ballistic missile submarines. Under the terms of the treaty, the missile launchers were required to be removed from the submarine and cut apart in a verifiable manner. For the first submarines, the submarine was inactivated and the missile compartment section of the submarine was dismantled using cutting torches. The remaining forward and aft sections of the ship were welded together and placed in floating storage. After the initiation of reactor compartment disposals at Puget Sound Naval Shipyard in the mid 1980s, the missile compartments were dismantled in parallel with removal of the reactor compartment. The remaining sections of the submarine were welded back together and the ship was placed in waterborne storage. With the initiation of total ship recycling in 1991, Puget Sound Naval Shipyard began accomplishing missile compartment dismantlement, reactor compartment removal, and ship recycling in a single drydocking evolution.

Missile compartment dismantlement employs the same cleaning, cutting, and removal methods used for dismantling the rest of the submarine. The missile hatches and the missile launcher tube liners are removed. The interior spaces are cleared to allow the hull to be cut apart. The hull and missile tube structure is dismantled using cutting torches. Equipment within the missile compartment removed prior to and during dismantlement, includes electrical equipment, piping, air flasks, lockers, partitions, and berthing furnishings. Where required, components are demilitarized to remove sensitive or classified design information, PCB impregnated sound damping material is removed and the residue is

cleaned from exposed surfaces. Asbestos insulating material and removable ballast lead are manually taken from the ship.

Reactor Compartment Disposal

The nuclear propulsion plants in U.S. Navy ships, while differing somewhat in size and component arrangements, are all rugged, compact, pressurized water reactor plants designed to exacting criteria in order to withstand severe power transients and battle shock. These compact plant designs, enclosed within the high strength steel hull of the submarine, tend to simplify disposal planning (as compared to large spread out land based nuclear power plants).

The defueling process removes the nuclear fuel, including unused uranium and fission products which are fully contained within the fuel elements. Although this removes over 99 percent of the radioactivity, some small amount remains in the reactor plant after the nuclear fuel is removed. This radioactivity was created by neutron irradiation of the iron and alloying elements in the metal components during operation of the plant. Approximately 99.9 percent of the remaining 1 percent radioactivity is radioactive corrosion and wear products which have been deposited on the inside of piping systems.

Cobalt 60, which has a half life of 5.27 years, is the dominant residual radioactive nuclide. It emits gamma radiation and is the primary source of radiation in the defueled reactor plant during reactor compartment preparation and shipment to the burial site. Experience shows the external radiation levels on the reactor compartments are low--below 1 mrem per hour at the hull surface except for one or two localized areas which do not exceed 30 mrem per hour. These levels drop to 1 mrem per hour or less at two meters distance from the hull. The radioactive corrosion and wear products are contained within two boundaries, the first being the sealed piping systems, and the second the welded hull and bulkheads of the reactor compartment.

The planning for reactor compartment disposal began in the late 1970s, and evolved in the early 1980s into a comprehensive public process under the National Environmental Policy Act. The Navy, with the Department of Energy as a cooperating agency, published a draft Environmental Impact Statement (EIS) discussing alterna-

tives in 1982. Public hearings were held in four states: North Carolina, South Carolina, California, and Washington. Copies of the draft EIS were made widely available. Over 1000 comments were received in the public hearings and comment letters. The final EIS, published in 1984, concluded that land burial of submarine reactor compartments at a federal government disposal site would not have any significant adverse environmental impact. On December 6, 1984, the Navy issued a Record of Decision to dispose of these reactor compartments at the Department of Energy's Hanford Site in eastern Washington.

The Hanford Site was selected because it was close to a navigable river, in a desert, and relatively close to Puget Sound Naval Shipyard where eight defueled submarines were already in floating storage. The other federal radioactive waste disposal sites did not have these combined features. Shortly after the Record of Decision was issued, the 1985 Low Level Radioactive Waste Policy Amendment Act became law, which identifies disposal of reactor compartments from naval ships to be a federal responsibility.

Reactor compartments also contain regulated quantities of hazardous and toxic materials in the form of lead and PCBs. The lead is in the form of permanently installed shielding which is not removed because of the great difficulty and significant personnel radiation exposure that would be involved. Felt sound-damping material containing PCBs is found on the interior of the hull, on bulkheads, and in other locations outside of the reactor compartment that are part of the disposal package. This material and any PCB residue are removed from the reactor compartment before disposal in accordance with EPA requirements. However, low concentrations of PCBs, totaling about five pounds, are found tightly bound in the chemical composition of rubber and insulating materials widely distributed throughout the reactor compartment. It is not feasible to remove these components and insulation, and they are left in place for disposal with the reactor compartment.

Reactor compartments are prepared for shipment and burial in accordance with Department of Transportation and Nuclear Regulatory Commission requirements for packaging and transportation of low level radioactive material, Department of Energy requirements for burial of low level radioactive material, Environmental Protection Agency requirements for disposal of PCBs, and

Washington State Department of Ecology requirements for disposal of lead.

Because of their radioactive content, the reactor compartment packages are designed to meet the packaging requirements of Title 49 Code of Federal Regulations-Transportation, and Title 10 Code of Federal Regulations-Energy. The reactor compartment packages will effectively protect the public and environment when subjected to normal conditions of transport as well as hypothetical conditions relating to heat, cold, pressure, vibration, drop, and puncture. The potential damage to the reactor compartment and its contents under the hypothetical accident conditions has been shown to not exceed specified limits for release of radioactivity.

When performing the reactor compartment shipments, the Navy has maintained close coordination with state and local officials. In 1986, Navy, Coast Guard, and Department of Energy officials met in Olympia, Washington, with representatives of the Washington State Department of Ecology, the Washington State Office of Radiation Protection, and the Nez Perce and Yakama Indian Nations, to review preparations for the first reactor compartment shipment.

Officials of the states of Washington and Oregon have been to the shipyard to review the transport barge and reactor compartment packages and to confirm the packages' radiation levels. This close coordination provides continuing assurance to the states and the public that these shipments meet all of the necessary requirements for transporting radioactive material, and do not represent a danger.

In preparation for removal of the reactor compartment from the ship, piping, electrical cabling, and other components that penetrate the reactor compartment bulkheads, or would otherwise interfere with its removal, are cut and removed. This work is accomplished with hand held saws, grinders, pipe cutters, and cutting torches. Special care is taken with piping containing radioactivity. These are high integrity systems designed to prevent any leakage. Any pipes which are cut are resealed to maintain the system integrity and, in combination with the package hull and bulkheads, provide redundant boundary containment of radioactivity. PCB-bearing felt is manually removed and the surfaces cleaned either by abrasive blasting or by hand scraping and wire brushing, followed, in some cases, by wiping with chemical and detergent rinses. Ballast lead

is manually removed.

The ship is drydocked with the reactor compartment supported by cradles. Tracks with rollers are installed under the cradles to allow the reactor compartment to be slid away from the ship once it is cut free. The reactor compartment is cut from the rest of the ship's structure with standard cutting equipment, predominantly torches and hand held saws, pipe cutters, and grinders. The hull cuts are made several feet forward and aft of the shielded reactor compartment to allow installation of shipyard fabricated end bulkheads. These are three quarter inch thick steel plates with heavy T-beam stiffeners. These plates are transported to the drydock, crane lifted into position, and welded into place after the reactor compartment is moved away from the rest of the submarine.

These submarines were designed for deep ocean operations and to survive combat engagements. Thus, the rugged design of the submarine reactor plant, the inherent strength of the ship's pressure hull and the shielded bulkheads, and the additional end bulkheads installed by the shipyard, provide the structural integrity needed to meet the packaging criteria for transporting the radioactive material contained in the reactor compartment. In addition, the entire package is air tested to insure package integrity. The shipyard also fabricates heavy steel support fixtures which are welded to the hull to facilitate jacking and transporting the reactor compartment. Jacking is accomplished in small increments, with blocks and shims placed under the compartments as they are raised to assure that the compartments do not drop in case of a loss of hydraulic jacking pressure.

The reactor compartment package is moved onto the barge using track-mounted, high capacity rollers for horizontal movement, and large hydraulic jacks for vertical movement. When in place, the compartments are welded to the steel barge deck.

Reactor Compartment Transportation

Barge shipment. The Navy reactor compartment shipments meet all Department of Transportation requirements for transportation of low level radioactive material. Beyond these requirements, the Navy employs additional conservative precautions designed to ensure safe shipment of the reactor compartments.

The barge is towed from the shipyard using a large commercial

American Bureau of Shipping certified ocean tug. The tow is accompanied by a second, similar backup tug and a Navy or Coast Guard escort vessel. The route follows the normal shipping lanes from the shipyard, through Rich Passage, past Restoration Point, and northerly through Puget Sound. The route is then westerly through the Strait of Juan De Fuca (staying in U.S. waters), past Cape Flattery, and southerly down the Washington coast to the mouth of the Columbia River (shipment departure times from the shipyard are calculated to allow passage across the bar at the mouth of the Columbia River on the incoming tide). The route is then up the Columbia River, following the Corps of Engineers maintained shipping channel used for the regular transport of commercial cargo. The ocean tugs are replaced with river tugs on the lower Columbia River. The river route passes through the navigation locks at the Bonneville, Dalles, John Day, and McNary dams, and finally to the Port of Benton located at Richland, Washington.

In addition to meeting Department of Transportation and U.S. Coast Guard requirements, the Navy takes extensive additional precautions to ensure the tow is safe and uneventful. Even though a barge accident is highly unlikely, credible scenarios have been analyzed. These analyses show there is no significant risk to the public or the environment.

The equipment and the transportation procedures are designed to minimize the potential for transportation accidents, to mitigate the consequences of an accident in the unlikely event one should occur, and to facilitate recovery if necessary. Care is taken to make barge accidents highly unlikely. For example, only experienced commercial towing contractors are used, with the advantage of employing people experienced in the work and the route, using regularly operated and maintained equipment. Two tugs are used, one for the tow and one traveling along as a backup to take over in case of a problem with the primary tug. Fully crewed, American Bureau of Shipping certified, commercial ocean tugs are specified for the two from the shipyard to the Columbia River. These vessels have more power than would be normally employed for a barge of the size and load-line rating used for reactor compartment disposal. Large pusher-type river tugs and backups having reserve engine capacity are used on the Columbia River.

All towing operations, including the route to be followed, operating procedures, and casualty procedures, are planned by the

towing contractor and approved by the Navy. Normal shipping lanes are used through Puget Sound to minimize the potential for collision or inadvertent grounding. The barge is equipped with flooding alarms. A backup towing bridle and tow line are installed on the barge with a trailing line behind the barge for bringing backup towing gear aboard the tug if the primary towing gear fails. Shipments are not made in the winter or when inclement weather is predicted. Shipments are also planned to avoid interfering with scheduled recreational events, such as boat races, on the low tide.

Licensed ship pilots are used in Puget Sound and on the Columbia River, and for crossing the Columbia River Bar. Shipyard personnel familiar with the towing procedures and the characteristics of the reactor compartment accompany each shipment to monitor the operations and provide advice to the tug captain if needed. Coast Guard personnel are also stationed aboard the escort vessel. With the above precautions, the potential for a towing accident involving the barge is much lower than the already small probability of accidents during routine barge traffic throughout the United States.

Each of the barges used is highly compartmented and is designed to maintain its upright stability with any two compartments flooded. The welds attaching the reactor compartment to the barge are designed to withstand the maximum forces associated with wind loading, list, trim, pitch, roll, yaw, and any credible accident. Also, the combined rector compartment and barge have sufficient reserve buoyancy to keep the barge afloat even if over half of the compartments were damaged and flooded. Therefore, a barge sinking would take an extremely unlikely accident scenario. Because the rector compartment sits well back from the sides of the barge and because the extremely strong exterior of the package can withstand severe accidents, breach of the reactor compartment due to collision is not considered a credible event.

Damage due to fire is also extremely unlikely. The transport barge carries no combustible fluids to support a fire. Also, the thick steel shell of the reactor compartment has a high capacity for absorbing heat and would not be damaged significantly if exposed to fire. In addition, the waterborne shipment environment would provide easy access to firefighting water to put the fire out.

There are no other credible accidents related to water transportation that could cause breach of the package and release of

radioactivity.

In the highly unlikely event it became necessary, the Navy has incorporated in the barge and package a number of engineered features to facilitate location and salvage. A buoy is attached to the barge and would float to the surface to mark its location. An emergency position indicating radio beacon would float to the surface and transmit a locating signal on a frequency monitored by the National Transportation Safety Board. Salvage capability is provided for the package to allow the attachment of salvage gear to raise the sunken reactor compartment package using commercial or Navy owned heavy lift ships if refloating the barge is not possible. The barge and package could be raised as a unit, or separated by divers for separate recovery, without any impact on the environment.

Offloading and land transportation. Offloading is accomplished at the Port of Benton at Richland, Washington. Facilities at the Port consist of a barge offloading slip constructed of sheet-piling cofferdams and rip-rap earthen bulkheads. The slip is periodically inspected both above and below water to ensure it is in good condition. Maintenance work is controlled under the provisions of an Army Corps of Engineers permit, and state and local permits and authorizations which are designed to protect river quality.

Before the barge is docked, divers inspect the slip to assure the gravel bottom is free of obstructions. The barge is placed in the slip and water is added to the barge compartments in a controlled sequence to ground the barge firmly on the gravel bottom of the slip, with the deck of the barge against and level with the top of the sill at the landward end of the slip.

The welds holding the reactor compartment package to the barge are cut, and the compartment is jacked up and placed upon four steel columns. A crane is not required for this work. As is done during dydock lifts, jacking is in small increments with support blocks and shims temporarily placed under the load to support the compartment if hydraulic jack pressure is lost. A transport vehicle is then moved onto the barge and under the package. The transport vehicle is commercially operated under contract. To date, these have all been multiple wheel high capacity trailers specially designed for heavy loads; however, high capacity crawler transport vehicles could also be used.

The package is attached to the transport vehicle using welded attachments, and raised off the support columns using jacking features built into the transport vehicle. The transporter is then driven off the barge, and the package transported approximately 26 miles to a burial trench at the Hanford Site. At the trench, the package is lowered onto foundations, the welded attachments to the transporter are cut free, and the transporter removed. The package is welded to the foundations.

The time from shipyard departure to placing the package in the trench is about five days, of which three days involve the barge transit.

Potential offloading and land transportation accidents would all involve dropping or toppling the package, or collision with another vehicle. Because of the package design, none of these accidents has the potential to release radioactivity.

The potential for mishandling the package is minimized in a variety of ways. Offloading and land transportation is accomplished under a Navy contract by commercial contractors experienced in handling heavy loads. Conservative engineering designs, load testing of equipment, the use of Navy approved written procedures, and independent monitoring of the work all minimize the potential for a problem. The transport vehicles that are used are designed to transport heavy loads and are very stable. The overland transit is coordinated by Hanford Site transportation personnel. Escort vehicles provide an escort and assure a clear roadway for the transporter, minimizing the potential for collision with other vehicles. The only train tracks along the route are located on the Hanford Site and used infrequently by trains transporting site materials at moderate speed.

Hanford is a 560 square mile (1450 square kilometers), mostly undisturbed area of relatively flat desert. The Columbia River flows through the northern part of the site. The Tri-Cities of Richland, Kennewick, and Pasco to the southeast is the nearest population center. About 376,000 people live within an 80 kilometer radius of the center of the Site according to the 1990 census.

From 1943 until very recently, Hanford was the location of DOE's reactor and chemical separation facilities for the production of plutonium for use in nuclear weapons. The work at Hanford is now primarily directed toward decommissioning the production

facilities, disposal of the wastes, and actions to remediate contamination that resulted from past operations.

The active Hanford Low Level Burial Grounds consist of eight burial ground sites that cover a total area of approximately 518 acres in the Site's 200 East and 200 West areas. The 200 East Area is located near the center of the Hanford Site on a plateau about 700 feet above sea level, and contains reactor fuel chemical separation processing facilities and various waste management facilities. The reactor compartments are placed in the 218-E-12B burial ground, one of two active burial grounds in the 200 East Area. This burial ground is an active landfill which began receiving waste in 1967.

Recycling

The program for total ship recycling was developed directly from experience gained in dismantling missile compartments. Similarly, the development of procedures for demilitarization and handling of hazardous materials evolved from the experience. In 1991, the Navy instituted a total ship recycling program following a review of options for disposal of the remainder of the submarines.

Disposal by sinking became impractical when the combined cost of demilitarization and hazardous material removal was added to the already significant cost of preparing the submarine for refloating, towing, and controlled sinking, and the cost of actually towing it to an authorized ocean location and sinking it.

General approach to recycling. There are two basic approaches that have been used to optimize in-dock submarine dismantlement. The first is to remove large sections of the ship's hull with most of the adjacent structure piping, cabling, and equipment still attached. The removal is accomplished in a planned and controlled dismantlement sequence involving about 460 major individual sections of hull and structure (for a ballistic missile submarine). The submarine's internals are stripped only to the extent necessary to allow hull sections and deck sections to be cut free. The removed sections are placed on a land transporter (usually a railcar or flat bed truck) and moved to a shipyard facility where they pass through a number of workstations to be processed into segregated recyclable materials and waste.

The second approach is to strip the interior of the submarine (except for some heavy machinery) including the removal of all hazardous materials. Then, the hull is cut into sections as in the first method. One advantage of this approach is that the ship's interior can be stripped before docking, shortening the in-dock time. This has become an important factor, as the increasing number of ships being recycled can potentially be limited by the drydocks available for hull cutup and reactor compartment preparation work. The other advantage is that the intact hull provides a good environmental containment for hazardous material removal operations inside the ship, including abrasive blasting.

The recycling process currently being used is actually a combination of the two approaches. Sections of the ship that can be easily stripped pierside are being stripped. Sections that have substantial interferences or other features that make shipboard stripping difficult, are being cut out for dockside disassembly and processing.

The shipyard has dedicated a drydock to the recycling of submarines that have already been defueled. It is divided by a caisson that allows new hulls to be docked while work proceeds on others. A track system allows partially recycled hulls to be moved from the seaward end to the landward end to accommodate the new hulls, and allows the reactor compartments to be moved aside for preparation for shipment. This dock can handle about eight hulls per year. Other drydocks are used to dock one or more submarines for reactor defueling. In this case, after defueling, the reactor compartment is prepared for disposal, and the remainder of the ship is recycled.

Shipboard dismantlement. There are a number of hazardous materials present in older submarines that need special controls for health, safety, environmental protection. However, most of these are present in relatively small quantities in discrete locations. The exceptions are asbestos, PCBs, and metallic lead which are present in significant quantities. Thus, one of the first actions when a submarine is recycled is to identify and tag equipment and structure that contain these materials. This includes shipboard testing to identify insulating materials (both on piping systems and on ship's structure) that contain asbestos or PCBs. This identification program allows the proper personnel safety and environmental controls to be established for shipboard dismantlement and in the

subsequent dockside handling, processing, and disposition of the removed materials.

In dismantling the submarine, care is taken to unbolt and remove equipment that will be refurbished and reused. However, the remaining non-reusable equipment, wiring, piping, and non-structural material is most efficiently removed by destructive processes. It is cut free using reciprocating saws, grinders, abrasive cutting wheels, hand held shears, plasma torches, and oxygen/Methyl Acetylene Propadiene mixture (MAPP) gas torches. The lighter materials are cut into pieces that can be manually loaded into large material handling containers.

The machinery in the aft section of the submarine requires considerably more work to remove than the lighter equipment and materials in the forward section. Much of this heavy equipment must be crane lifted, even when cut into pieces. Large holes are cut in the top and sides of the submarine's hull to facilitate removal of material from the ship during the early phases of dismantlement. Material handling containers are either lowered into the ship or placed alongside where material can be placed into them. Larger equipment is moved under a hull cut where a crane can lift it out of the ship.

Electrical wires and cables are cut using both hydraulic and manually operated cable cutting shears. Larger diameter piping is cut with hand-held abrasive cutting machines having wheels up to 12 inches in diameter. Smaller diameter piping is abrasive cut or sheared. Hand-held plasma cutting torches are also used on non-ferrous alloys. Light metal items such as partitions and ventilation ducts are sawed or abrasive cut. All removed materials are cut into sizes that can be manually placed into the material handling containers.

Insulating materials are manually removed and disposed of as waste. Asbestos is removed in isolated areas with controlled and filtered ventilation. The work is accomplished by personnel who are specially trained in asbestos work. They wear protective clothing and breathe filtered air. Procedures such as wetting are employed to minimize the amount of fibers that become airborne. The work areas are monitored to assure the air quality remains within prescribed limits. The waste material is bagged, identified, and disposed of in accordance with established requirements.

PCBs are encountered in significant concentrations in felt sound

damping material. On early submarines this material is found throughout the ship. This damping material is installed under bolted metal plates against hull or machinery foundation structures. These are often covered with additional insulating materials. The covering plates and the impregnated felt are manually removed and disposed of as PCB waste. The work is done in controlled areas by personnel wearing protective equipment. Where entire interior areas of the hull are stripped and cleaned, high capacity steel abrasive blasting equipment is used to remove the PCB residue. The areas to be abrasive blasted are isolated from the rest of the ship and provided with controlled and filtered ventilation. Personnel wear full body protective clothing and are supplied with breathing air. The steel abrasive is recovered and reused. The PCB waste is packaged and disposed of in accordance with applicable requirements.

Lead ballast in the way of hull sectioning work is manually removed from the bilge pockets. The individual pieces generally weigh about 60 to 100 pounds.

The heavy steel hull and structural materials are cut with hand-held oxygen/MAPP gas torches capable of cutting hull material at speeds up to 18 inches per minute. Extremely thick components such as shafts are cut with an oxygen lance (a consumable metal tube containing metal filaments and fed by an oxygen supply).

The recycled metals are segregated by type: stainless steel, carbon steel, aluminum, monel, brass, cooper, etc. to the maximum extent practicable. The heavy steel hull and structural steels are loaded directly into commercial railcars. The other metals are placed into large metal boxes or shipyard gondola railcars and taken to the local Defense Reutilization Marketing Office (DRMO) facility. This scrap metal is sold using either a onetime sale contract, or a term contract, awarded to the highest bidders. Reusable equipment not needed by the Navy or Defense Department is sold to private bidders through the DRMO.

A typical recycling generates about 2,500,000 pounds of HY-80 steel, 600,000 pounds of steel, 20,000 pounds of sheet metal, 110,000 pounds of stainless steel, 8,000 pounds of galvanized steel, 85,000 pounds of aluminum, 250,000 pounds of brass/-bronze, 150,000 pounds of monel, 90,000 pounds of copper, 6,500 pounds of zinc, and up to 1,800,000 pounds of lead.■

NEW YORK HARBOR IS TO THE SUBMARINE AS DAYTON, OHIO IS TO THE AIRPLANE

by COL John P. Sinnott, AUS(Ret.)

The practical development of the submarine in New York Harbor is a story that unfolded over more than 100 years as a tale of technical genius, spies, good old Yankee bravery, foreign intrigue, and a surprisingly good safety record—in which no lives were lost in spite of the inherently dangerous nature of the work.

The adventure began with the world's first submarine war patrol, when Continental Army Sergeant Ezra Lee sailed in David Bushnell's one-man submarine, TURTLE, from the foot of Whitehall Street (about where the Staten Island ferry slip is now located) into Upper New York Bay at 11 PM on September 6, 1776 to sink HMS EAGLE, the flagship of the British fleet. The British fleet, under the command of Admiral Earl Richard Howe, was anchored in Upper New York Bay preparing for a final assault on Washington's Army, encamped on Manhattan Island, that, if successful, would end the American Revolution.

It was during this time that David Bushnell, a Yale alumnus from Saybrook, Connecticut, completed his work on TURTLE. Called TURTLE because the hull looked like two tortoise shells joined together, the boat had a manually cranked screw propeller, ballast pumps, and a snorkel-like breathing device. TURTLE also carried an explosive device, or *magazine*, as it was called. The magazine was a 150 pound charge of gunpowder, detonated by a clockwork time delay mechanism, after being attached through an auger to the wetted hull of EAGLE. The novelty and efficiency of Bushnell's TURTLE was considerably more than just astonishing. For example, TURTLE had a working screw propeller, an achievement generally credited to John Ericsson, who used screw propulsion on USS MONITOR during the Civil War, 86 years later, and a wave-activated breathing tube—snorkel gear—which would not again see operational use on a submarine for another 160 years!

We can only stand in awe of Sergeant Lee's courage as he sortied his tiny submarine against the wilderness of masts, spars and rigging for over 200 British ships that cluttered the Upper Bay. Sergeant Lee made his way under EAGLE or possibly HMS ASIA,

another large ship of the line riding at anchor near EAGLE. Unfortunately, after several attempts, Sergeant Lee was not able to attach the magazine to EAGLE's hull. The reason for this failure seems to have been caused by the auger on the magazine which was not able to penetrate the copper sheathing on EAGLE's hull or was applied to impenetrable ironwork on the ship's rudder.

With the approach of sunrise, Sergeant Lee discontinued his attack, setting his course for the return trip to Whitehall. Because TURTLE's compass failed, Sergeant Lee had to surface every few minutes to correct his course, causing his unusual craft to be sighted by some of the British soldiers occupying Governor's Island. A few of these soldiers set out after him in a 12 oared barge. With the barge coming within 50 or 60 yards of TURTLE, Sergeant Lee released the magazine and TURTLE's pursuers promptly returned to Governor's Island. The magazine drifted past Governor's Island into the East River and, in Sergeant Lee's own words, "went off with a tremendous explosion, throwing up large bodies of water to an immense height."

George Washington, who may have observed the attack from the roof of a house on Broadway, subsequently wrote of Bushnell that he was "...a man of great mechanical powers—fertile in invention—and a master in execution."

Bushnell, with help from his brother Ezra, had built TURTLE, for security purposes, in a shed behind the house of Captain Richard Sill, which house stills stands at remote Ayer's Point in Saybrook on the Connecticut River. Trials and shakedown cruises, some of which were observed by Benjamin Franklin, were conducted on a desolate stretch of the Connecticut River.

A personal friend of David Bushnell, Dr. Benjamin Gale of Killingworth, Connecticut, wrote several letters to Silas Deane, a member of the Continental Congress, describing TURTLE and seeking financial support from Congress for the project. In Killingworth, however, a man named Sheader held three jobs. He was the town tavern keeper, the town postmaster, and a British spy! Sheader routinely intercepted Dr. Gale's correspondence with Silas Deane and, in this way, knowledge of TURTLE reached Vice Admiral Molyneux Shuldam, Commander-in-Chief of the British Squadron in North America, who did not seem to take the reports of TURTLE too seriously.

Soon after Sergeant Lee's first war patrol, the British landed on

Manhattan Island and Washington's forces withdrew to the northern part of the island, taking TURTLE along in the general retreat. Two more sorties were made with TURTLE from Manhattan Island against some British frigates in the Hudson River. Fort Washington, the place from which these last sorties were launched, was located near what is now the George Washington Bridge foundation on the New York side of the Hudson River.

One attack from Fort Washington was undertaken by Sergeant Lee and another attack was made by Phineas Pratt, the artisan who built the magazine time delay firing mechanism. Both attacks failed and TURTLE was hoisted aboard a sloop that served as the world's first submarine tender. The sloop, with TURTLE aboard, was sunk by a British frigate a few days after the last sortie, and although TURTLE was recovered, no future use was made of the boat.

The eventual fate of TURTLE is not known, although one of Phineas Pratt's magazine firing mechanisms is in the Connecticut Historical Society's collection. TURTLE may have been scuttled near Fort Washington or, as some believed, returned to the shed at Ayer's Point. The story of TURTLE, however, is not complete without mentioning a thought provoking report from Captain Thomas Hardy, commanding HMS RAMILLIES off New London, Connecticut during the War of 1812. Captain Hardy reported that his ship had been attacked by a "privateer submarine." This attack, too, had failed. A hole had been drilled in RAMILLIES' hull but the screw for attaching the explosive to the ship broke, preventing the magazine, once more, from being fixed to the hull. We do not know, but could this have been the brave little TURTLE's last sortie against the might of the Royal Navy?

It seems only fair to reflect very carefully on that first war patrol during the night of September 6 and 7, 1776. Because Sergeant Lee and TURTLE did not sink a British vessel, the sortie has gone down in history as a failure. Apart from sinking one British ship, or less than one-two hundredth of the opposing fleet, what greater result might have been expected from TURTLE's sortie? Could this one little boat compel the British to be more cautious in deploying the fleet around Manhattan Island? Could TURTLE gain a little more time for Washington's army to prepare for the next British move? Or could one little vessel in some way make the Continental Army's escape from Manhattan a bit easier?

These were exactly the results achieved through Sergeant Lee's attack on EAGLE. TURTLE forced a powerful British fleet to "cut their cables" and retreat from the Upper Bay, sail through the Narrows between Brooklyn and Staten Island, and find a new anchorage in Princess Bay at the southeastern end of Staten Island. The British adopted, moreover, the future practice of sweeping the underside of each hull with chains to detect attached magazines.

One submarine, with one magazine, crewed by one soldier actually forced a fleet of more than 200 ships to retreat several miles to a safer anchorage! This certainly was a feat of outstanding gallantry with a result unparalleled in naval history, compared with which the failure to sink one enemy vessel among a fleet of more than 200 ships borders on the insignificant.

Any doubts about Bushnell's TURTLE and what Sergeant Lee later wrote of his single-handed sortie against the entire British fleet in 1776 were swept away when, on Saturday, August 20, 1977, Connecticut Governor Ella Grasso christened a full scale replica of TURTLE and launched it into the Connecticut River. The replica, built by boat builder Frederic Frese and photographer Joseph Leary, then undertook a successful mock attack on a ship anchored offshore. The TURTLE replica performed as promised in every way and the replica is now on display in the Connecticut River Museum in Essex, Connecticut, near Saybrook, the place where modern submarine warfare was born. A half scale cutaway of TURTLE, moreover, can be seen at the Submarine Force Museum, Naval Submarine Base, Groton, Connecticut.

The next submarine to dive beneath the water around New York Harbor came under construction during the Civil War. Confederate trials with submarines to break the Union blockade are reasonably well known. What is not well known, however, is the North's experiment with a submarine that began at the same time.

Construction was undertaken in 1863 at Newark, New Jersey, of a submarine known as INTELLIGENT WHALE. INTELLIGENT WHALE, built of one-half inch thick boiler iron, generally in the shape of a huge football, was 30 feet long, about 9 feet deep, and had a speed of four knots when the propeller was cranked by a full crew of 13. INTELLIGENT WHALE was completed in 1866 and was tested by the Army Corps of Engineers on the Passaic River, that flows into New York's Upper Bay. INTELLIGENT WHALE dove successfully in the Passaic River to a depth

of 16 feet. While the boat was underwater Corps of Engineers General T.W. Sweeney, dressed in a diving suit, left INTELLIGENT WHALE through an air lock and attached a mine to a scow; the mine exploded, destroying the scow.

Eventually, INTELLIGENT WHALE was acquired by the Navy and moved to the Brooklyn Navy Yard for further tests. The record is not too clear, but in 1872 there was an accident which, without loss of life or injury to personnel, delayed the boat from surfacing. As a result, the boat was condemned and ultimately was moved to the Washington Navy Yard where it continues to be on display.

The last phase of submarine development in New York Harbor began a little over 100 years after TURTLE's first war patrol. Just across the Hudson River, about 10 miles west of Fort Lee, New Jersey, John P. Holland launched his first submarine in the Upper Passaic River. This boat, HOLLAND NO. 1, went into the water near the Spruce Street Bridge in Paterson, New Jersey on May 22, 1878. HOLLAND NO. 1 cost about $10,000, a sum that was advanced through a Skirmishing Fund established by the Fenian Brotherhood. Once more the target for this work was the Royal Navy. It was hoped that Holland's submarine might challenge the Royal Navy to a degree that would help liberate Ireland from the British. The money for HOLLAND NO. 1, however, was not advanced until Holland was able to prove its principles to the Brotherhood by operating a 30 inch working model in a demonstration at Coney Island.

Construction started on HOLLAND NO. 1 in 1876 at an iron works on Albany Street in the present-day lower Manhattan financial district. The hull, which was 14-1/2 feet long with a beam of 3 feet, was moved in 1878 to Paterson for completion and on June 6, 1878, Holland made several successful dives in the Passaic River and thus presented the modern submarine to the navies of the world.

Holland and the Brotherhood, concerned because the work was under observation by British intelligence, scuttled HOLLAND NO. 1 in the Passaic River when tests were completed. HOLLAND NO. 1 was raised in 1927, and the hull was placed on public view at the Paterson Museum, where it still remains on display.

Because HOLLAND NO. 1 was such a success, the trustees of the Fenian Skirmishing Fund ordered a combat submarine from

Holland. This submarine, FENIAN RAM, was armed with a pneumatic gun in the bow and was manned by a crew of three. FENIAN RAM, which cost the Skirmishing Fund about $18,000, had a beam of 6 feet and a length of 31 feet.

FENIAN RAM was built at Delamater's Iron Works, a shipyard that was located at the foot of West Thirteenth Street in Manhattan. Launched in the Hudson River in May of 1881, the submarine was first tested at Jersey City in the Morris Canal Basin, a large inlet just opposite Manhattan's Battery Park and a little more than a mile north of Ellis Island. Subsequently, FENIAN RAM was berthed at the Crescent Yacht Club in Bay Ridge, Brooklyn.

The Fenians then ordered a third submarine. This third boat was under construction in Jersey City where, in late November 1882, a dissident group of Fenians slipped into the dockyard and launched the unfinished boat. They then took both FENIAN RAM and her new launched sister ship in tow behind a tug and headed up the East River to Long Island Sound and New Haven. Choppy water and an improperly secured hatch caused the new boat to sink in the East River off Whitestone Point under more than 100 feet of water, where it probably rests to this day. After some years, however, FENIAN RAM was moved to the Paterson Museum, where it can still be seen.

With the theft of FENIAN RAM and her sister ship still fresh, a discouraged Holland was introduced to Lieutenant Edmund L. Zalinski, an Army artillery officer posted at the time to Fort Hamilton in Brooklyn.

Lieutenant Zalinski, a prolific inventor of military devices, considered his pneumatic dynamite torpedo gun a potential submarine weapon. Joining with Holland, Lieutenant Zalinski found some private financing, organized the Nautilus Submarine Boat Company, and undertook with Holland construction of what became known as the Zalinski Boat on the parade ground at Fort Lafayette, a fort that was demolished some years ago to provide the foundation for the Verazzano Narrows Bridge near the Brooklyn shore.

The Zalinski Boat had a wooden hull mounted on iron frames, was 50 feet long and had a maximum beam of 8 feet. The boat was to mount one of Lieutenant Zalinski's pneumatic dynamite guns. The launching on September 4, 1885, however, was a disaster! The launching way collapsed, throwing the Zalinski Boat into some

pilings that holed the hull. Raised and repaired, the Zalinski Boat made a few disappointing trial runs in the Narrows. Underpowered, the Zalinski Boat was never satisfactory in performance and soon was scrapped.

Possibly the most important result of the Zalinski Boat was that it kept a discouraged Holland active in submarine development. Thus, after a few years Holland built two more boats. These submarines, however, were not Fenian Skirmishing Fund ventures but were built with the U.S. Navy as the customer. HOLLAND VI, later to become USS HOLLAND (SS 1), was launched into the waters around New York Harbor on May 17, 1898 from Lewis Nixon's Crescent Shipyard, Elizabethport, New Jersey. Initial trials for this, the most famous of all of Holland's boats, were conducted off Staten Island in Raritan Bay near Tottenville and in Princess Bay—the old British fleet anchorage. Tests for the Navy were carried out on November 12, 1898 in Lower New York Bay in the general area between the Old Orchard Shoal Light and Sandy Hook, New Jersey.

During these trials, Robbins Dry Dock port and berthing facilities at Fiftieth Street in Brooklyn were ordinarily used for HOLLAND IV.

Because of crowded harbor conditions, further development was carried out on eastern Long Island in Little Peconic Bay between Orient and Montauk Points. The facilities of the Goldsmith and Tuthill Yard in Suffolk on the north shore of the bay were used for this purpose. The Goldsmith Yard ultimately built the submarines ADDER, MOCCASIN, PORPOISE and SHARK for the Navy, thus becoming the world's first modern submarine shipyard.

A Holland competitor, Simon Lake, born in Pleasantville, New Jersey, began working on a submarine design about 1890 at Atlantic Highlands, New Jersey, near the entrance to New York Harbor. Lake's plan for his ARGONAUT submarine, rejected by the Navy in 1892, eventually led him to design and build with private funds a smaller ARGONAUT JUNIOR. ARGONAUT JUNIOR, launched into the Shrewsbury River in New Jersey in 1894, had a caulked double hull of yellow pine with a layer of canvas between the two pine layers. The boat had a hand-cranked propeller, a compressed air tank coupled to a plumber's hand pump, and four wooden wheels for running on the bottom, two of the wheels being hand-cranked through a chain drive. The boat

had a door and Lake drove his little vessel around on the bottom of New York Bay, picking up clams and oysters and even spearing fish through the opened door.

After some time, Lake moved his activity to Bridgeport, Connecticut, where he built a number of boats for the United States, Austria, Italy, Germany and Russia. One of the boats that he built for the U.S. Navy, USS SEAL, was given a hull number of 19-1/2, the only fractional hull number ever assigned to a Navy vessel.

The submarine did not depart from New York Harbor, however, without a final touch of intrigue. Just before the Russo-Japanese War, Lake smuggled one of his boats, PROTECTOR, to Russia through a rendezvous in Princess Bay with a merchant steamer and a derrick. The derrick hoisted PROTECTOR on board the steamer, which then carried its contraband cargo to a Russian destination. This last act ended New York Harbor's direct involvement in the development of the submarine, most of which happened within the Statue of Liberty's benign gaze.■

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THE PERSIAN GULF AND FULMINATE MARINE CORROSION: ARCHAEA MICROBIALS VS. SUBMARINES

by Richard Rosenblatt, M.D.

Dr. Rosenblatt is a board-certified anesthesiologist (retired), having been in both academia and private practice, and is a member of the Naval Submarine League.

The deployment of nuclear attack submarines into the Persian Gulf constitutes an important aspect of the U.S. Navy's Maritime Strategy as it relates to this vital area of the world. The physical attributes of the Persian Gulf—its shallowness, numerous navigation hazards and poor acoustic environment—all contribute to hinder underwater operations. An ancillary development, recently noted, may further complicate the ability of submarines to operate within the Persian Gulf on a routine basis: two double-bottom commercial oil tankers, relatively new, were found to have sustained extensive corrosion soon after exposure to a marine microbial in the Persian Gulf.[1] A similar pattern of extensive corrosion appeared in a U.S. Navy nuclear submarine upon completion of an extended deployment to this region. An Archaea microbial is most likely the presumed biological entity responsible for these unusual presentations of fulminate marine corrosion.

Archaea are the microorganisms that live adjacent to hydrothermal vents (black smokers) at the mid-ocean rifts found during underwater explorations by deep diving submersibles.[2] These microorganisms are distinctly different from either bacteria or eukarya (cellular organisms that possess intracellular structures) and have been classified as an entirely new domain.[3] Their discovery ranks as one of the most important recent advances in microbiology. Archaea are now known to be distributed worldwide existing in soil, subterranean deposits and marine environments.[4,5] These microbials can survive under some rather extraordinary conditions which otherwise were thought to be incompatible with life. Archaea have the unusual ability to utilize sulfur or its derivatives as their principal source of biochemical energy, doing so in a reductive, anerobic, non-photosynthetic environment and are seemingly insensitive to high ambient pressure or temperature.

The biochemistry of Archaea is thus singularly unique. Scientists believe that Archaea play a significant role in the deposition of metal ores and biotransformation of petrochemicals.[6] It has been postulated that, given the age of the earth and enzymatic activity of the estimated Archaea biomass, these microorganisms have biotransformed at one time or another the entire mass of the minerals found in the crust of the earth.[7] Their biochemical dexterity and appetite for petrochemicals are no less impressive. Following the massive oil spills that occurred in Alaska and elsewhere, the rapidity of petrochemical bioremediation has surprised the scientific community. The full extent of the contribution made by these microbials to geologic processes remains to be determined.

Archaea, by similar means, are seemingly able to corrode the hull and other components of ship construction. The American Bureau of Shipping (ABS) reported recently that a fulminate form of marine corrosion had taken place in the voids of the two previously mentioned double-bottom oil tankers (an anaerobic environment contaminated by petrochemical spillage).[1] The pattern of corrosion observed in the tankers was unusual. The worst damage was sustained by high-tensile and stainless steels, which corroded in layers rather than through more common surface pitting. Alarmingly, protective coatings proved ineffectual; bactericidal chemicals and algicides used to clean the bilge only accelerated the rapidity of marine corrosion. This disturbing development has prompted the ABS to form a special task force to investigate this problem and make recommendations for corrective action. The situation has assumed paramount importance with reports of double-bottom oil tankers discharging contaminated bilge contents laden with foreign biological matter into harbors throughout the world.[8]

While the two episodes of fulminate marine corrosion have involved to date double-bottom oil tankers, it is not unexpected that submarines with their analogous structure, use of high-grade steels and persistent submergence should be vulnerable to a similar pattern of damage by a sulfur-digesting Archaean. Recent events appear to confirm this supposition. The United States and Iranian navies have conducted prolonged submarine operations in the Persian Gulf; both navies have incurred assorted damage from biologically-induced marine corrosion in their respective subma-

rines.

One U.S. submarine returned from an extended submerged deployment to the Persian Gulf with a highly unusual and extensive pattern of marine corrosion; this despite a complete refit prior to the deployment. All seals on the propeller shaft were compromised, the packing on the periscopes were leaking seawater into the control room, and the crew was forced to decant and recycle hydraulic fluid that had been contaminated with seawater on the transit back to the submarine's homeport.

The magnitude of the corrosion found on the submarine while it was in drydock upon its return was startling. The hull and propeller had visible corrosion that resembled the marine equivalent of smallpox. The hull had patches of corrosion that appeared to have flaked off layers rather than showing the normal randomized pitting, similar to what had been observed previously in the double-bottom oil tankers. Neither the fiberglass sonar dome nor the silicate anechoic tiles had demonstrable damage. The zinc galvanic plates located on the dorsum of the submarine forward of the propeller likewise appeared unaffected and void of overt electrolysis. Evidence of corrosive damage was likewise found within the submarine. Black rubber fittings, exposed to the contaminated hydraulic fluid, showed an advanced state of decay; when handled the rubber disintegrated into a granular powder. In sharp contrast, Tigon™ tubing in direct contact with the contaminated hydraulic fluid and the corroded rubber washers was intact. These findings were subsequently reported in an abstract written by the author and Captain J.H. Patton, Jr., USN(Ret.) accepted for presentation at the 1996 NATO Undersea Defense Technology Conference.

Inspection of the submarine further disclosed additional confirmation of marine corrosion by a sulfur-digesting Archaea microbial. A number of barnacles were recovered from free-flooding spaces within the hull. Dissection of the barnacles revealed a prominent black growth ring midpoint in the cross-section of the shells, consistent with the time spent by the submarine in the Persian Gulf during its deployment. A black inclusion body was encapsulated within the barnacle which smelled and tasted of sulfur. A similar finding has been noted in tubular worms and clams that live next to deepsea hydrothermal vents. The Archaea colonies in these environments subsist by means of

chemosynthesis on a diet of sulfur emitted from the vent. Sulfur and its derivatives, however, are toxic to the non-Archaean organisms that comprise the vent community but which depend, in turn, on the Archaea as their basic source of nutrition. The sulfur intolerant lifeforms resolve this dilemma by segregating the sulfur residues into a sac-like organelle contained within their bodies.

A second indication of Archaea infestation in the hull of the submarine was found as well. Located on the intakes of the secondary propulsion unit was a deposit of greyish-white ash several centimeters thick that was covered by a proteinaceous layer. The material had a putrid odor characteristic of hydrogen sulfide. Similar findings of a proteinaceous mat and cellular debris with sulfide residues have been reported by oceanographers investigating underwater hydrothermal vents and the associated Archaea colonies.[9]

The unusual biological properties of the Persian Gulf did not go unnoticed by the submarine's crew. After the first month's deployment in the operational area, the submarine was covered by a several-centimeters-thick layer of marine growth adherent to the outer hull that likewise had a most noxious odor associated with it. The marine growth on the submarine's hull was so extensive that it had a profound impact on the boat's performance despite repeated attempts at removal: a loss of six knots of speed was measured during the return transit.

Analogous difficulties have been encountered by the Iranian Navy with the operation of their Russian built Kilo class submarines based at Bandar Abbas. Jane's Defense Weekly has published several accounts that indicate the Iranian Navy has experienced a marked reduction in the operational readiness of their submarine force due to extensive corrosion from marine growth fouling hulls and clogging multiple valves.[10] [11] Maintenance problems were previously reported with the submarine batteries sold by Russia and, more recently, India for the Kilo submarines. Although it is conjectural, contamination of the bilge water by Archaea microbials and subsequent spread within the battery compartment could result in premature failure of the rubber casings of the lead-acid batteries. The presence of Archaea in the waters of the Persian Gulf is not unanticipated, given the availability of sites favorable for their growth.

Archaea are organisms commonly found in the micro-ecologic

environment of hydrothermal and volcanic vents. The Middle East and, in particular, the Persian Gulf contain numerous indications of geologic and volcanic activity. An extensive deepsea rift in the Red Sea consists of a linear expanse of volcanic vents spewing 350°C water, hydrogen sulfide and dissolved minerals.[12] [13] This rift in the earth's crust extends around the eastern border of the Arabian Peninsula and then curves in a northerly direction. It proceeds into Oman whereupon it crosses the Strait of Hormuz. There it encounters the Makran subduction zone, an area where the Arabian tectonic plate impacts and slides underneath the Iranian segment of the Euro-Asian continental plate. The northern border of the fault is demarcated by a volcanic arc in S.E. Iran some 300 km. inland.

The Persian Gulf is a marginal sea that overlies the zone where the two respective tectonic plates are colliding. The Zagros Mountains, which flank the northern border of the Persian Gulf, arose as a result. Volcanic activity and hydrothermal sites are often found at these geologic junctures. In Oman there exists an enormous geological formation, termed the Omani ophiolites, which is the remnant of volcanic activity. The notable absence of geothermal surface activity in either northern Oman or southeastern Iran can be attributed to the lack of sufficient groundwater in the surrounding areas. The analogous underwater sites along the fault line, nevertheless, should be geothermally active despite the lack of surface manifestations, and thereby provide the necessary habitat for Archaea to thrive.

Other geological formations in the proximity of the Strait of Hormuz substantiate the existence of past and current hydrothermal sites in this area. In northern Oman pillow lava is found, indicative of underwater volcanic eruptions. Various mineral deposits, formed by seafloor hot springs, are likewise found throughout the region. The presence of underwater geothermal sites is further indicated by measurements that show increased water and crust temperatures for the Strait of Hormuz and surrounding area in comparison to the average water temperatures found throughout the Persian Gulf; this despite the greater depth of the sea in the locality.[14] Lastly, the Persian Gulf has some of the highest biomass densities found to date anywhere in the world's oceans. One of the remarkable attributes of Archaea colonies living next to hydrothermal vents is their unusually high biomass densities, far more than

the comparable biomass densities of mid-ocean seawater.[15]

It is the conclusion of the author that the submarine in question was damaged by a biological casualty, Archaea, a microorganism known to inhabit underwater geothermal sites, such as those that presumably exist in the vicinity of the Strait of Hormuz. Furthermore, Archaea microbials seem to have the unique propensity to produce an accelerated, fulminate pattern of marine corrosion. Until detailed oceanographic analysis of the Persian Gulf is undertaken, these observations cannot be confirmed with absolute certainty. With the political situation of the Persian Gulf being what it is and the current acrimonious state of relations that exists between the United States and Iran, it is doubtful that such definitive research will be feasible in the foreseeable future.■

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THE SPIRIT OF HUMAN BOMBS

by CDR Thomas J. Belke, USNR

All material in this article has been obtained from unclassified sources.

> The quick falling cherry blossom,
> That lives but a day and dies
> with destiny unfulfilled,
> Is the brave spirit of Samurai youth,
> Always ready,
> his fresh young strength
> To offer to his lord.
> -Ancient Japanese Poem [1]

In warfare, knowing what makes one's opponent "tick" might also suggest his tactic. Recently shifts in North Korean Juche ideology have included their incorporation of a bushido-like "spirit of human bombs" ideology along with an armed forces loyalty oath that both mirrors and is influenced by that adopted by Japan just prior to World War II. This recent shift in Juche ideology suggests that the U.S. Navy should be ready to counter immediate North Korean suicide tactics in the event of potential hostilities.

Have you ever heard about the inspiring lessons-learned brief by the highly decorated kamikaze pilot who was a veteran of forty missions? Or maybe you've heard the old Cheech and Chong album with the skit about Hashimoto, the kamikaze pilot, sitting in the back of the room when he and his fellow fliers are directed to "...take kamikaze plane up, up, up into sky and down, down, down into Yankee aircwaft cawier—blowing yourself up and all aboawd." As the leader is wrapping up the brief, he asks the pilots if there are any questions. Hashimoto raises his

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[1] Nicolai Timenes, Jr., *Defense Against Kamikaze Attacks in World War II and its Revelance to Anti-Ship Missile Defense, Volume I An Analytical History of Kamikaze Attacks Against Ships of the United States Navy During World War II* (Arlington: Center for Naval Analyses, November 1970), v.

hand and says, "Yeah, man—are you out of your...mind!?"[2]

Possibly, such jokes may seem mildly humorous to us because we feel safe in knowing that the massive waves of kamikaze attacks by Japan against the United States Navy are something from yesteryear. We feel fairly confident that such attacks are unlikely ever to be repeated. Also, the memories of shipboard fires, explosions, carnage and the loss of American blood associated with kamikazes have faded from our collective memories. Yet, even as you read this article, the ideological foundation is already in place for history to repeat itself. Though the threat is again in East Asia—this time it is from the other side of the Sea of Japan: North Korea.

Red Flag Ideology: North Korea's Quest for National Reunification

In the 1830s and 1840s a wave of national revolutions swept across Europe influencing many European nations (e.g., Italy, Germany and Rumania) to adopt tricolored flags. During the Paris riots of January 15, 1831, the red flag made its first modern appearance as the universal symbol of international revolution.[3] In 1849, as Karl Marx systematized Communist ideology, the red flag replaced the black flag of anarchy as the favored flag of the Communist revolution.[4]

Almost a century later in Siberia, a young Korean revolutionary named Kim Il Sung (1912-1994) rejected the Christian faith of his mother for the surrogate gospel of Communist atheism. Like many other aspiring young foreign national leaders, Kim spent the World War II years studying Communism in the Soviet Union in preparation for establishing totalitarian socialist states in his homeland

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[2]Expletive deleted.

[3]These riots inspired Victor Hugo's famous scene in the classic play, *Les Miserables*, were revolutionaries unfurled and waved red flags atop barricades erected across Paris' streets.

[4]James H. Billington, *Fire in the Minds of Men: Origins of the Revolutionary Faith* (New York: Basic Books, Inc., 1980), 159, 281. Dr. Billington, a leading expert on Marxist-Leninism, is the Librarian of Congress.

upon completion of the anti-Fascist war. At the end of the war in 1945, he took control of the reins of North Korean government and eliminated all those who opposed him becoming dictator. On May 1, 1948, Kim Il Sung, with the backing of the Soviet Union, defied the planned United Nations plebiscite and declared the establishment of the Democratic People's Republic of Korea (DPRK).

Without going into details, over the next four decades or so, Kim Il Sung, principally with the help of Hwang Jang Yop[5] ("the architect of Juche"), crafted a religious-like totalitarian system called "Juche"[6] (self reliance). To get an approximate recipe for Juche—start with Marxist-Leninism and add a hefty dose of secular humanism. Then marinate this mixture with 17th century "Hermit Kingdom" xenophobic isolationism, Confucianism and ancient Korean ancestor/king-worship. Toss in three quarters of a cup of Japanese occultism/idolatry, one rounded teaspoon of perverted Christianity, add two pounds of rice, a cup of bean paste, and toss in a handful of garlic, ginger, black pepper, spring onions, a bit of soy sauce/sesame oil, and some crushed roasted sesame seeds as desired (the basic flavors for any Korean recipe), season-to-taste with Chinese Maoist cultural revolution-style Communism—and bake in an East Asian oven at 39° North Latitude for fifty years.[7] Serves—or rather, enslaves—23 million.

By the time of his death in 1994, the "Great Leader" Kim Il Sung had been worshipped under Juche as father-god-savior throughout North Korea. He also established the ideological groundwork for his son, the "Dear Leader" Kim Jong Il (1942-) to succeed him in power as another god of Juche. According to Juche beliefs, Kim Il Sung and Kim Jong Il are the Su-ryong (literally "leader" or Fuhrer) who are attributed to have super-human powers. Kim Jong Il commands absolute allegiance by his million-

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[5]Hwang Jang Yop defected in February 1997 at the Republic of Korea's embassy in Beijing, China. Following extensive negotiations, he eventually left China for the Philippines and eventually arrived in South Korea.

[6]Sometimes "Juche" is translated into English as "Chuch'e" or "Chuche".

[7]Charmaine Solomon, *The Complete Asian Cookbook* (Rutland, VT: Charles E. Tuttle Company, Inc., 1992), 437. Actually the only portions of the recipe from the cookbook are the spices, rice and bean paste.

plus military personnel and all the 22 million other inhabitants of the land.

The cause of national reunification and the consummation of the revolution is considered sacred to Juche. Juche takes advantage of the Korean people's natural nationalistic desire for reunification and puts a totalitarian spin on it. Each year, crowds of hundreds of thousands parade through the streets of Pyongyang passionately expressing their ardent devotion to the Su-ryong, the Party, and the cause of National Reunification (on North Korea's terms). Under Juche, national reunification has taken on a sacred JIHAD/crusade-like significance. In contrast to what many world leaders believe, this core belief can never be negotiated away at international peace talks even in the face of endemic starvation and international diplomatic, military and economic pressure.

A comparison of the differing international and national versions of the DPRK's propaganda helps to illustrate the irreconcilable sacred nature of Juche national reunification. The world is presented with the kinder-gentler-reasonable North Korean position. For example, in an October 8th, 1997 speech before the United Nations in New York, North Korea called for a one government/two systems on the peninsula pledging that they would respect the political freedom in the South. Meanwhile, at home, the hard-line "Communization of the South" vision prevails. For example, on the very same day as the UN speech—but halfway around the world—Korean Worker's Party leaders collectively renewed their vows to complete the sacred cause of national reunification to reunite Korea under the personal rule of Kim Jong Il.[8]

In recent years, Juche has taken a new more radical shift to the left (if that were possible) through the introduction of "Red Flag Ideology." Like everything in Juche, Red Flag Ideology bears the "made in Kim-country" label since Juche must, of course, be "self reliance." And, according to the *Korean Central News Agency* on September 12, 1997, it was, of course—you guessed it—"the General's [Kim Jong Il's] idea."

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[8]Korean Central News Agency, October 8, 1997 http:www.kcna.co.jp. Remarkably, North Korean propaganda officials failed to detect the contradiction between their United Nations proposal and the positions articulated in their domestic Party speeches published on the same day.

Just as Juche took a major philosophical turn away from Marxism-Leninism, Kim Jong Il's recent introduction of "Red Flag Ideology" may represent the introduction of a new super-zealot phase of Juche for the "Juche Era" of the 21st century. Kim Jong Il first used the term "Red Flag Ideology" in his November 1, 1994 thesis, "Socialism Is Science" published in *Rodong Sinmun* (a major DPRK propaganda organ). His essay explained the term by saying that "this phrase is an expression that my ideology is red." The next year, *Rodong Sinmun* began using the term as an official catch phrase during the commemoration of the 25th anniversary of the founding of the Korean Communist Youth League. For example, the August 28, 1995 issue carried an article entitled, "Let us hoist high the Red Flag." A partial explanation of "Red Flag Ideology" was presented in the January 9, 1996 issue of *Rodong Sinmun*. In a commentary entitled, "The Red Flag Philosophy Is an Expression of the Revolutionary Spirit Based on Juche Ideology," the paper declared that Juche and Red Flag ideology were closely connected with each other. However, no details were provided.

Since then, joint editorials of three major newspapers on the first days of 1996, 1997 and 1998 called upon the people to abide by the "Red Flag Ideology." These New Years editorials take on a greater significance than in years past because they replaced the traditional New Year Message of the supreme leader. Like Juche ideology, the "Red Flag Ideology" also calls upon the people to embrace the spirit of self-reliance, the revolutionary struggle and spirit, and to become **"bullets"** and **"human bombs"** to protect the Leader. For example *Rodong Sinmun's* January 1, 1998 Joint New Years Editorial declared, "We should firmly defend General Secretary Kim Jong Il and guarantee his absolute authority in every way in the spirit of defending the leader at the risk of life and the **spirit of human bombs."**[9] The following 1997 propaganda article demonstrates the "human bombs" connection with "Red Flag Ideology" while notably omitting the term Juche:

> *Korean Central News Agency, September 30, 1997:* To **defend the red flag is, in essence, a sacred struggle to safeguard the leader,** says *Rodong Sinmun* in a signed

[9]Ibid., January 1, 1998.

article today. The article says: Secretary Kim Jong Il is the top brain and great standard-bearer of the Korean revolution who is leading the Korean revolution to victory, upholding the red flag.

Our red flag represents the idea and will of the General to accomplish the Korean revolution as intended by President Kim Il Sung and his indomitable stamina to defend socialism without wavering under any circumstances. The Korean people are determined to become an impregnable fortress and shield to safeguard the General at the cost of their lives. Their firm determination is to share their destiny with the General forever, upholding him as the supreme leader of the Party and the revolution.

Holding this red flag, our people are defending the idea of the leader most purely with resolute revolutionary principles and uncompromising struggle they are most resolutely safeguarding the safety of the leader **in the spirit of human bombs** and they are highly exalting the absolute authority of the leader through their devoted struggle. **If we are to defend the red flag of the revolution, the banner of defending the leader, we should have absolute worship for and unshakable faith in the leader** and follow him with a noble sense of conscience and obligation.

Even if we die while resolutely safeguarding the General, it is glory. It is the unbreakable faith of the Korean people to become an impregnable fortress to safeguard the General at the cost of their lives and **deal telling blows to the enemy**. No matter how the world may change, they will defend the headquarters of the revolution headed by the General and thus glorify their honor as revolutionaries (emphasis added).[10]

With only partial information in hand, this new ideology looks like a more radical version of Jucheism aimed at keeping the collective consciousness of the masses focused on Juche purity. This radical shift may be intended to counter what Kim Jong Il perceives as the threat of growing outside influence on North Korea. However, the historical allusion to the red flag as the

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[10]Ibid., September 30, 1997.

symbol of international revolution and the direct association of red flag ideology with "the spirit of human bombs" invites further discussion.

Bushido Incorporated into Juche!?

Less than 60 years ago, and roughly 600 miles to the East, the Japanese used exactly the same "spirit of human bombs" terminology the North Koreans are now using in conjunction with their World War II suicide campaign. Like today's North Koreans, the Japanese used "the spirit of human bombs" in the context of radical allegiance to and worship of a god-king. The Japanese framed this radical allegiance within the concept of the ancient samurai code of "bushido" (the chivalric code). A review of the Japanese precedent is helpful to more fully understand the implications of the North Korean's recent adoption of "the spirit of human bombs" terminology.

Certainly the notion of self sacrifice is a part of any nation's view of wartime heroism. Numerous nations award posthumous decorations to those who chose, either through premeditation or in the heat of combat, to sacrifice themselves to save a friend or destroy an enemy. However, the recent history of East Asia tells us "spirit of human bombs" is something more than mere self sacrificial bravery.

The Japanese initiated an entire military campaign which featured deliberate suicide with religious emperor-worship overtones as a standard military tactic. Suicide with special honor had long existed in Japanese samurai mythology and history. These traditions included the "hara-kiri" or seppuku (ritual suicide in expiation of dishonor or defeat). Japan transformed such ancient traditions into modern religious norms for the Japanese military. On January 8, 1940, almost two years before Pearl Harbor, Japanese General Hideki Tojo ordered that the "Sen Jin Kun" (Battle Ethics) be distributed to all officers and men both at home and abroad. This order made the unwritten code of the samurai the required conduct of all Japanese servicemen:

> A sublime sense of self sacrifice must guide you throughout life and death. Think not of death as you push through with every ounce of your effort, fulfilling your duties. Make it

your joy to do everything with all your spiritual and physical strength. Fear not to die for the cause of everlasting justice. Do not stay alive in dishonor. Do not die in such a way as to leave a bad name behind you.[11]

As the tide of war turned strongly against Japan in 1944, voluntary kamikaze suicide attacks began at the Battle of Leyte Gulf in the Philippines. Then, early in 1945, the Japanese Imperial General headquarters issued an order that all armed forces should emphasize suicide tactics.

These tactics included not only the much publicized attacks by kamikazes and Baka bombs, but also suicide weapons platforms such as a special midget submarine with underwater fins, an explosive motorboat, the human torpedo, and a small submarine about 30 feet long which would attach explosives by suction or magnetic methods to enemy ships.

Also, the "human bombs" special weapons program featured "human mines," "suicide frogmen" (Fukuryus), Ohka glider-bombs and "crawling dragons."

We should keep in mind that, given the religious aspects of the missions, all of these "human bomb" programs had tens of thousands of volunteers—certainly more than enough. The religious "on a mission for god" character of these missions carried with them the unbearable social stigma of shaming one's family should a serviceman refuse a suicide mission. It is entirely meaningless to split philosophical or psychological fine points as to whether the individual soldiers or sailors willingly or unwillingly "volunteered." The result was the same. In practice—no real man ever wavered. In the tradition of the bushido code, young men instead spoke of the glory of death, saying, "I go to die for my country. It fills me with humility to have been selected by the emperor."

In 1945, Lieutenant General Kawabe, Deputy Chief of the Japanese Imperial General headquarters, said:

The pilot did not start out on his mission with the intention

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[11]Dennis and Peggy Warner, with Commander Sadao Seno, JMSDF-(Ret.), *The Sacred Warriors, Japan's Suicide Legions* (New York: Van Nostrand Reinhold Company, 1982), 5, 6.

> of committing suicide. **He looked upon himself as a human bomb** which would destroy a certain part of enemy fleet for his country. He considered it a glorious thing...we had no shortage of volunteers (emphasis added).[12]

After World War II, the United States Strategic Bombing Survey concluded that, by war's end, the "volunteers" were more reluctant. However, the extent of the opposition of those selected was largely limited to statements of lament. One kamikaze pilot, who was only saved from flying his mission by Japan's surrender, said that he "saddened to tears at receiving the death sentence [although]...it is unmanly to say so." Such sentiments did not result in any large scale refusal by Japanese servicemen to attempt their missions as ordered.

Though the terminology differs slightly, North Korea has accomplished the same thing through the sacred teachings of Juche, Red Flag ideology and a personal oath of allegiance to Kim Jong Il. Kim Jong Il's loyalty oath, like Tojo's Sen Jin Kun, adds the cultural force of morality and honor (as misguided and warped as they may be) to suicidal allegiance.

The Spiritual Roots of Suicide Tactics

As we consider the possibility of the reintroduction of mass suicide tactics in East Asia, it is helpful to consider how the "suicide spirit" came to "the land of the morning calm." To answer this question, let's turn the clock of history back more than seven centuries and go, instead, to "the land of the rising sun."

The year is 1281. Just seven years ago the Japanese had repulsed a Mongol invasion on Japan's beaches. Part of the Mongol fleet had also been wrecked in a storm. Kublai Kahn, having conquered China, recently sent ambassadors to Japan demanding their acquiescence to Mongol rule. Japan answers these overtures by killing and mutilating the Mongol ambassadors. The Kahn is displeased. Now, Kublai Kahn, ruthless ruler of most of the Eurasian land mass, is determined to launch a major Mongol invasion of Japan.

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[12]Warner, 76.

As the story goes, the Japanese mikado (ruler) is more than a little bit concerned. So the mikado summons all the sorcerers of Japan and asks them which god is the strongest. He will turn to whichever god is the strongest for Japan's deliverance. The sorcerers advise the mikado that the sun goddess is the strongest —so the mikado invokes the sun goddess' protection.[13]

As expected (and as provoked), Kublai launched an invasion force of somewhere between 50,000 and 200,000 undefeated veterans in a Mongol armada made up of thousands of small ships. Then, out of nowhere, a typhoon sprang up and destroyed over 4000 Mongol ships. Japanese historians of the day called this miraculous storm the "kamikaze" ("divine wind"). The Japanese attacked the surviving Mongols with suicidal ferocity through land and sea attacks. Mongol casualties were estimated to be as high as 150,000—though there is no way of knowing for sure; however, the invasion was repulsed. Few of the Mongol attackers survived the debacle. Though he desired to, Kublai Kahn never mounted his intended third invasion of Japan.

Grateful for Japan's salvation, the mikado entered into spiritual intercourse and union with the sun goddess through the Daijosi ceremony. This is the origin of the Japanese emperor being worshiped as a god-king to the Japanese people (and why the sun appears on the Japanese flag). Every Japanese emperor through Hirohito (who renounced his divinity in 1945) has entered into the Daijosi ceremony.[14] A Christian understanding of Daijosi views this ceremony as the invocation of demonization by Japan's ruler on both an individual and corporate/national level.

The Japanese religious conviction of their spiritual superiority shone forth in the 1930's in their oppression of the Korean people. Japan's enforced idolatry, especially among Korea's thriving Christian community of the late 1930's, was particularly totalitarian in nature. For example, on March 1, 1919, Japanese soldiers surrounded one Korean church, nailed its doors shut and burned over 400 Christians alive. Finally, by late 1938, the Japanese had

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[13]Peter Lee, "The Spiritual Struggle for Korea" *Cornerstone Ministry Monographs* (Seattle: Cornerstone Ministries, International, 1997), 2, 3.

[14]Incidentally, the Japanese reinstituted the Daijosi ceremony for their emperor in 1992!

systematically broken the will of the last holdout denomination of Christians. As a result, Shinto idolatry was officially sanctioned by all Korean Christian denominations. Among the lesser known explanations for the Japanese surprise attack on Pearl Harbor, most Japanese leaders were convinced by December 1941 that the power of Shinto was greater than the Christian God of the United States.[15] Their victorious experiences over Tzarist Russia, and more recently in China and in Korea fueled their confidence. As the tide of the war turned against Japan, Japanese leaders again invoked the power of their sun goddess in conjunction with the kamikaze campaign and use of other suicide weapons platforms such as Kaitens.[16] Remarkably, like the Mongol fleet, Admiral William "Bull" Halsey's fleet was hit by two major typhoons in December 1944 and June 1945—also with tragic loss of life.[17] However, neither the kamikazes nor the typhoons (regardless of the natural or demonic origin attributed to the "divine wind") altered the outcome of the Pacific War.[18]

The Link: Japan's Spiritual Influence on North Korea

Having noted the Japanese origins of "the spirit of human

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[15]Ibid., 3. Since the Japanese (in 1940) and today's North Koreans view(ed) Christianity as a "political-religious tool of American imperialists", it is meaningless, at least in this context, to split fine points by noting that Christianity originated in Asia or that millions of Americans have abandoned the Christian faith. The Japanese of the World War II era and today's North Koreans view Christianity as coming from America—whether one likes it or not.

[16]For more in-depth discussion of Kaitens, see Major Jessie W. Canaday, USAF's article."The Japanese Kaiten Weapon: The Desperate Measure for Desperate Times" in the April 1994 issue of THE SUBMARINE REVIEW.

[17]Halsey came close to not being awarded his fifth star due to losing more ships in the typhoons than in many of his battles.

[18]In 1945, General Douglas MacArthur apparently noted that the Japanese viewed the Christian God of the Americans as having proved Himself superior to the Japanese sun goddess. MacArthur met with church leaders and requested that American churches send one thousand Christian missionaries to completely evangelize Japan.

bombs," let's now take a look at the link: Japan's spiritual influence on North Korea. From a spiritual history perspective, there is more to "the spirit of human bombs" than an idle academic comparison between similar "human bombs" statements out of two possibly unrelated cultures. In fact, Korea was under Japanese domination for most of the first half of this century.

Much of the 1904-1905 Russo-Japanese war took place in northern Korea in the Pyongyang area. Japanese armies established bases on the Korean peninsula and defeated the Tzar's armies in a campaign that culminated in their decisive victory at Port Arthur. By 1910, the Japanese forced the abdication of the Korean king and annexed the entire Peninsula as a Japanese territory. To reduce the risk of revolt, the Japanese began systematically reeducating the Korean people. Shinto idolatry was enforced while Christians were persecuted. Japanese was taught to children in public schools and the use of the Korean language was strictly outlawed for official use. Korean cultural traditions were forcibly replaced by their Japanese equivalents. Korean Christian churches and church schools were the last holdouts against these Japanese policies until, as already noted, they finally capitulated in 1938. Thus, an entire generation of Koreans was forced to partake in Shinto baptism and bow before Shinto shrines. These Shinto shrines were small houses with a picture of the Japanese emperor and his sun goddess consort. In a spiritual loyal sense, the act of worshiping Shinto idols during the 41 year Japanese occupation (1904-1945) made the Korean nation vulnerable to the full spectrum of Japanese demonics influence...including "the spirit of human bombs".

Elements of the modern Juche "religion"[19] recall elements of ancient Korean sun god worship that bear a striking resemblance to Japanese Shintoism. For example, Korean legend holds that the first ancient Tangun king was conceived when the sun god had intercourse with a she-bear on Korea's sacred mountain—Mt. Paektu. (Recall the similar 13th century Daijosi Japanese tradition.) Today, Kim Il Sung (1912-1994), his wife Kim Jong Suk (1919-1949) and their dictator son Kim Jong Il (1942-) are

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[19]My use of the albeit controversial term "religion" to describe Juche will become clear upon reading my upcoming book *Juche!—The State of Religion of North Korea*. However, such a discussion is beyond the scope of this article.

referred to in Juche revisionist history and current propaganda as "the three generals of Mt. Paektu."[20] In a manner reminiscent of the Japanese occupation, Kim Jong Il, like his father before, requires every Korean home to prominently display their pictures. Additionally, all North Koreans must bow and render homage before the great bronze statue of Kim Il Sung in Pyongyang. And, not surprisingly, Kim Jong Suk is now being elevated to goddess status[21] to bolster Kim Jong Il's claim to deity. Moreover, the North Koreans under Juche are even more radically anti-Christian than the Japanese ever were.

Speculation or Alarm?: Evaluating the Indicators

In the U.S. Submarine Force, every submariner is taught over and over and over to "believe your indications." Below are a number of indications that, by themselves, may be insignificant. Together, however, I believe they may present a mosaic that may rightly be viewed with alarm. By indications I do not refer to common knowledge such as that North Korea is a hard-core totalitarian state with the fourth largest standing army in the world. Nor do I refer to the steady stream of anti-American propaganda such as the May 4, 1997 statement by the *Korean Central News Agency* that "The DPRK and the U.S. are in a state of war."[22] That is not new. Let's summarize what is:

- **The increasing use of "the spirit of human bombs"**

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[20]For example, DPRK propaganda, national educational curricula and even a 1997 speech by the DPRK's vice president all refer to dictator Kim Jong Il's birth on Mt. Paektu, Korea's sacred ancestral mountain. However, Kim Jong Il was actually born in Vyatak in the vicinity of Khabarovsk in the Far Eastern region of the ex-Soviet Union while his father, Kim Il Sung, was being trained by the Soviets as a Communist revolutionary.

[21]On December 24, 1997, Kim Jong Suk's birthday was first celebrated as a North Korean national holiday (a Juche holy day?!) With accompanying statutes, parades, speeches, celebrations, propaganda and ongoing revisions to "official" history.

[22]"U.S. bellicose elements criticized for their reckless act," *Korea Central News Agency* (DPRK) 3 May 1997 (http://www.kcna.co.jp).

terminology by North Korean propaganda organs. Over the last year, when Kim Jong Il has inspected Korean People's Army (KPA) units, the soldiers have chanted "human bombs!, human bombs!, human bombs!" and pledged themselves to prove their allegiance to him to the death.[23]

- **The bushido-like personal oath that all North Korean military personnel have taken to Kim Jong Il.** Kim Jong Il is systematically inculcating North Korea's military with a "suicide spirit".
- **The introduction of "Red Flag ideology."** As discussed, this represents a leftward—more-radical—shift in the Juche variant of the international Communist revolution. Remember that "Red Flag" ideology is inherently linked with both national reunification (on North Korea's terms) and "the spirit of human bombs."
- **The execution of North Korean servicemen in a failed 1996 submarine mission.** Why were eleven of the twenty four North Korean servicemen immediately lined up and killed by their own comrades during the September 1997 submarine grounding at Kangnung.[24] Might they have willingly died to fulfill their loyalty oath to Kim Jong Il and thereby expunge the dishonor of failing in their mission? We should not be too quick to force-fit a "western" answer to questions surrounding this East Asian submarine incident.
- **A photo taken from a North Korean propaganda film.** This photo shows DPRK commandos gathered around a model of a U.S. aircraft carrier. *(Editor's Note: Due to the slightly blurred condition of the photo it was unsuitable for inclusion here.)* The context of the film suggests that the North Koreans view the carrier as a symbol of American imperialistic oppression. You get the point.

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[23]Navy protocol footnote—if, perchance, you should ever be invited to inspect a KPA unit—please don't bring a ship's plaque. Instead, follow Kim Jong Il's standard practice by giving them a picture of yourself, a pair of binoculars and a machine gun.

[24]See my article entitled "Incident at Kangnung—North Korea's Ill-fated Submarine Incursion" in THE SUBMARINE REVIEW's April 1997 issue.

- **Remarks by North Korean leaders show that they know that they are totally outclassed by U.S. naval and air power from the outset of any future hostilities.** Consequently, North Korea may not repeat the "too little too late" decision in World War II by the Japanese who waited to adopt suicide tactics.
- On January 28, 1998, North Korea directly associated "the spirit of human bombs" with suicide air attacks for the first time.

> The KPA [Korean People's Army] officers and men have been firmly imbued with **the spirit of human bombs** under the slogan "Let us safeguard the headquarters of the revolution headed by General Kim Jong Il with our lives". Among them are **hero Kil Yong Jo who sacrificed himself for the safety of the headquarters of the revolution by piloting his plane, not bailing out of the plane when it was out of order**....in defence of the authority of Supreme Commander General Kim Jong Il... The KPA has grown up to be the crack force which is superior to any formidable enemy in political and ideological, strategical and tactical aspects and in military technique... The KPA is a model of society in all aspects including spiritual and moral traits, fighting spirit, cultural and emotional life.

Considering the Possiblities

Today, decision makers in the field probably have more information available to them than ever before. However, more information does not make the actual decision to fire (or not to fire) any less difficult. Thus, commanders must prepare as best they can for possible crises by walking the thought processes through "what if" scenarios. It is my hope that this article will better equip U.S. Navy leaders to seriously consider the "what ifs" associated with encountering possible suicide attacks.

Hopefully my research, analysis, reasoning and the possibilities presented herein are completely wrong. I would be most happy to live with that possibility. But what are the implications if I am

right? Given both the outright spiritual influence on North Korea from the Japanese occupation and the parallels between their belief systems, and the North Korean's widespread use of "the spirit of human bombs" terminology, we should ask ourselves:

- Does the Japanese "spirit of human bombs" of the early 1940s represent the same entity as the North Korean "spirit of human bombs" of the late 1990s?
- Is there any real possibility of a North Korean coordinated suicide campaign?
- Have we underestimated the threat presented by possible suicide strategy and tactics?

Such a campaign could be rooted in the prevalent Juche belief of North Korea's leaders, like the Japanese before them, that their anointed dictator-god Kim Jong Il, "the [spiritual] son of Mt. Paektu," can defeat America. Remember—from the North Korean mind set, there is not a compartmentalized western division between the spiritual, political, military and diplomatic positions. All are rolled into one under the Su-ryong's banner of Juche.

Though, from a tactical doctrine development perspective, the use of suicide units suffers from the obvious absence of a "lessons learned" feedback loop (remember—no "veteran kamikaze pilots"), even the possibility of their moderate tactical effectiveness is cause for serious concern. History shows that such suicide tactics might include some combination of air, surface, submarine, frogmen and terrorist forces on U.S. warships. Adoption of such tactics retains the possibility of a cheap North Korean kill of a large-platform (high value unit/target) without the diplomatic "downsides" of NBC[25] weapons of mass destruction.[26]

Though I started out this article with a couple of jokes, Pearl Harbor was not a joke 57 years ago. Similarly, just 53 years ago, kamikazes were not a joke, either—nor should they considered to

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[25]Nuclear, Biological, Chemical.

[26]One of several historical examples of the success of such tactics is the disabling of the two British battleships, HMS QUEEN ELIZABETH and HMS VALIANT by three two-man Italian midget submarines at Alexandria, Egypt on December 19, 1941. The Italians escaped.

be so today. My intent in writing this article is to raise the issue of the very serious and very real possibility of a modern day recurrence of the coordinated and sustained use of suicide attacks by North Korea against the United States Navy in the event of possible hostilities. Remember Pearl Harbor—yes—but remember Okinawa too. Once again we need to be prepared to face "the spirit of human bombs."■

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IN MEMORIUM

CAPT Joseph W. Beadles, Jr., USN(Ret.)
Mrs. Jack N. Darby
Mr. Robert Fleet
CDR Howard Allen Hill, USN(Ret.)
CAPT Russell Knowles, Jr., USN(Ret.)
Mr. Bernard M. Vesper

A POWER ELECTRONIC REVOLUTION

by LT Michael G. Badorf, USN
Engineer Officer
USS HAWKBILL (SSN 666)

Lieutenant Badorf's paper won The Naval Submarine League Essay Contest while a student at the Submarine Officers Advanced Course 97060.

Introduction

The ability of the Navy to integrate current technology into shipboard systems is a hotly debated question. Unfortunately, we have not completed the task very effectively in recent years. Plagued by manpower and budget reductions, the Navy's constant state of flux has left it struggling to keep up with operational commitments. However, an obligation exists to our sailors to provide them with the best tools to carry out their mission. In addition, the American public deserves the most capable fleet available for their protection and money. To accomplish these aims, Department of Defense (DoD) initiatives like the Dual-Use Applications Program (DUAP) have been undertaken to leverage commercial research, technology, and products into military systems. One of the most promising projects sponsored under DUAP is the Power Electronic Building Block (PEBB) concept. Overseen by the Office of Naval Research (ONR), PEBB is a programmable power module capable of meeting a variety of power conversion tasks. Applied to submarines, PEBB will revolutionize shipboard power distribution by improving platform reliability and survivability in conjunction with significant weight and space savings over traditional AC networks.

PEBB Concurrent Engineering

Throughout the Cold War, the DoD drove technological development in the United States. Following World War II, the utility of advanced weapons systems provided the DoD with a counterbalance to Soviet numerical superiority. As a result, technological breakthroughs were always being made to keep weapons systems current. When the Berlin Wall fell, however, the

apparent threat to the United States evaporated. In addition, the American public demanded DoD procurement reform as reports of $700 hammers made headline news. The resultant impact of these occurrences, combined with downsizing, forced the DoD to find ways to pursue acquisition reform under former Secretary of Defense Perry.

DUAP emerged as a product of the reform measures. Implementation of DUAP allows the Navy to pursue shipboard application of the PEBB concept in a cost effective manner by capitalizing on commercial sector developments in electric power. The process, known as concurrent engineering, gives the Navy the opportunity to lower its R&D overhead and benefit from the latest technology breakthroughs. Commercialization of PEBB also ensures rapid development since market interest exists outside the military. Finally, mass production and supply of PEBB gives the Navy reduced procurement costs and a readily available source of stock—commercial-off-the-shelf concept at its best.

PEBB Background

In the early 1990s, advances in semiconductor manufacturing technology allowed for the production of rugged, high power density switching devices. Coupled with improvements in digital control techniques, PEBB came into being. The basic construction of a PEBB module includes switching devices, control circuitry, and filter elements. The design leads to the fundamental versatility of PEBB. In concept, all the power modules within a particular electrical rating are the same. Thus, as long as sizing is correct, one power module can be substituted for another. The PEBB module receives its particular identity only when software is loaded into the control circuitry. In effect, a user with limited electronics knowledge can construct a reliable power distribution network on the first try. All the user must do is choose the proper sized *blocks* for the application, connect them together, and program them accordingly. In its final form, the user would employ a PEBB network by selecting the desired power conversion function either locally or remotely. Programs resident in the control circuitry would then align and run the switching devices to achieve the desired output.

Submarine Applications

With the advent of PEBB, the Navy's focus has shifted to employing a DC zonal electric distribution (DC ZED) system on its newest platforms—most notably the Surface Combatant for the 21st Century (SC-21). The DC ZED implementation not only eliminates large AC transformers and mechanical switching devices but also reduces miles of cable runs into two main DC feeders. As a result, the system design achieves significant space and weight savings. More importantly, compartmental auctioneering and fewer bulkhead cable penetrations serve to enhance platform survivability. Combining these factors with PEBB's low maintenance requirements produces a power distribution system suitable for submarine application.

The proposed architecture of the DC ZED system is shown in Figure 1. In this distribution network, AC or DC source(s) supply the main DC feeders. An AC source and its associated rectifier bridge are shown for illustration purposes. The unregulated DC power is distributed via port and starboard busses from the source(s) into designated zonal areas throughout the ship. Each zone contains PEBB modules programmed as either Ship Service Converter Modules (SSCMs) or Ship Service Inverter Modules (SSIMs). The SSCM is used in each zone to step-down the distribution bus voltage to a regulated DC level for use in the Zone. In this way the SSCM inserts intelligence into the system by acting to buffer, pre-regulate, and fault protect each zone.

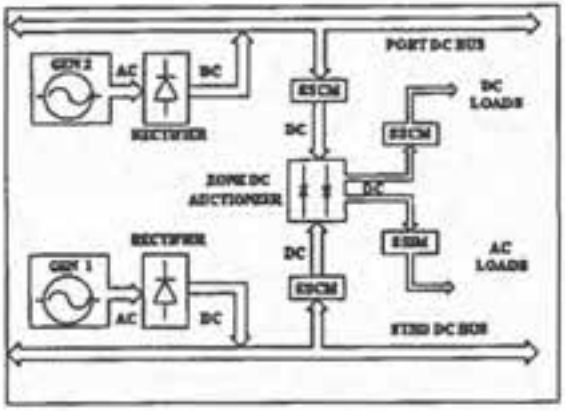

Figure 1. Integrated Power System

Electric loads within the zone are fed by either SSCMs or SSIMs depending on the load's requirement for DC or AC power respectively. Specific advantages resulting from the design include:

- ease of maintenance/troubleshooting due to component modularity
- enhanced power continuity due to auctioneering
- improved watertight integrity due to fewer and smaller bulkhead penetrations

This list is by no means all-inclusive but serves to highlight the most significant features of the DC ZED system.

Conclusion

Once fully operational, PEBB power conversion devices will form a vital cornerstone in the development of naval electronic systems. As such, application in the submarine environment logically follows due to PEBB's weight, size, and survivability advantages. Based on concurrent engineering, PEBB development is a cost effective solution to DoD and Navy budget constraints. Additionally, the program will serve as a benchmark for commercial-off-the-shelf implementation. Truly, an *electronic revolution* is at hand, and PEBB is leading the way.■

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TURBULENT TUBBY LINTON

by CDR R. Compton-Hall, RN(Ret.)

The Victoria Cross, Britain's highest military award, has been won by a total of 14 Navy submariners in both World Wars. The VC, a bronze cross simply inscribed For Valour, compares with the Congressional Medal of Honor. This is Part 6 of an eight-part series.

The Victoria Cross has been awarded for exceptionally hard fighting over a long period rather than for a single act of valor. This was the case with Commander John Wallace Linton, 35 years old in 1940: he was a submariner of 13 years standing, and a commanding officer for five, when he brought the cumbersome 2000 ton P class submarine PANDORA—big for those days—from the China station to join the First Submarine Flotilla at Alexandria in May of that year.

He had been a first class rugby forward, often on the same side as *Crap* Miers of TORBAY fame (**THE SUBMARINE REVIEW**, July 1997). When he gave up serious rugger in 1937 he was soon tipping the scales at 17 stone (238 pounds): not being very tall his nickname inevitably became *Tubby*. Miers, who was himself held in awe, remembered:

> "He looked, and was, a most fearsome man with heavy black beard; and most of us, with only slightly less seniority, stood in great awe of him. He was quiet but decisive in demeanour and speech, and when he expressed his disapproval he was generally right.
>
> "His crew, as well they might, held him in great respect. They had complete confidence in him; and he was probably the most technically efficient of all our commanding officers as he was also about the oldest of us all. [Only two other COs in the submarine service were older.] His mathematical genius was such that he could generally do the attack calculations in his head more quickly than the instruments supplied for the purpose." [In truth, however, mental aids to attacking were not hard to acquire.]

HMS PANDORA was well armed with six bow and two

stern tubes and a four inch gun; but slow, reluctant to turn and unable to go safely below 200 feet—she was not suited to a brisk fray in the claustrophobic Mediterranean. In the Spring of 1941 she helped to inaugurate the *magic carpet* from Gibraltar to besieged Malta, embarking key RAF personnel, spares for fighter aircraft, and 102 bags of mail. Then she spent several months in the Atlantic, supporting convoys in the Biscay and Azores areas—a dull and unrewarding watch. However, Linton was allowed back into the Med for a morale-restoring patrol of Sardinia where he gleefully sank two Italian supply ships.

That was not much of a haul for a total of 251 days at sea before going to Portsmouth, New Hampshire for refit in June 1941; but on 3 July 1940 Linton had claimed a victim which he would prefer to forget.

When the armistice between France and Germany was signed on 25 June 1940 it became imperative, for Britain, that the fourth largest fleet in the world should not fall into German hands. The Royal Navy's regrettable, and regretted but necessary, bombardment of French capital ships in harbour at Mers-el-Kebir in 3 July is well recorded; but PANDORA's reluctant role off Algiers is not.

PANDORA was ordered to attack any French warships encountered outside the port, and on 4 July Linton sighted the minelaying sloop REGAULT DE GENOULLY through the periscope at a range of three miles. He was already broad on the target's bow, on an opposite course, and unfavourably positioned for a submerged snap attack with his non-angled straight-running torpedoes. Nevertheless he immediately increased to full speed, turned to a firing course, and brought the range down to 3800 yards before firing a hosepipe salvo nine minutes after the first sighting. Three out of four torpedoes hit—a remarkable result with rapidly estimated data against a smallish target at three times the optimum range (theoretically 1250 yards on about a 100 degree track). The approach was masterly; but Linton did not savour his success.

Towards the end of 1941 Linton took command of the new T class submarine HMS TURBULENT—a handier, sleeker, smaller, mechanically more reliable boat than PANDORA and less liable to suffer telltale oil leaks. She was armed with eight bow tubes (two

of them external) and three external tubes firing astern[1]: 17 torpedoes were carried. She also had a four inch gun and three portable bridge-mounted .303 machine guns. There was no radar. Fire control remained rudimentary with no angling for torpedoes except for the option of selecting a preset 90 degree right or left on the six internal bow tubes: the latter wizardry had to be mentally added to, or subtracted from, the calculated Director Angle (DA or aim-off): with the hosepipe salvo, the algebra was pretty well guaranteed to throw the fire control team. Endurance on the surface was as good as PANDORA; but the disappointing feature of the otherwise excellent T boats was speed—still no more than nine knots submerged for one hour and 14 or 15 knots on the surface. Linton was to suffer the frustration of pounding across the Tyrrhenian Sea to intercept a squadron of three Littorio class battleships only to find himself smelling funnel fumes from six miles in their wake: a German workhorse Type VII U-boat, let alone a U.S. Navy fleet-type submarine, would have had time and to spare for heading them off.

Tubby Linton brought TURBULENT into Alexandria on Friday, 13 February 1942. The Squadron Captain, *Sam* Raw, spin doctored the superstition-prone date to predict that it would be "an unlucky one for the Axis powers".

During TURBULENT's second war patrol six small vessels were sunk by gunfire; but minor damage was sustained from a counterattack after approaching a convoy until, maddeningly, ranges were too short for torpedoes to run true. Linton's patrol report, telling of *pretty close* depth charges, assured Raw that: "this gratuitous and quite unprovoked [*sic*] insult will, I hope, shortly be avenged".

Tubby Linton—stern, stout, caustic, physically and mentally tough—steadily added to his bag. Although he was never regarded with a newsworthy triumph his non-stop chipping away at enemy resources was praised as "outstandingly successful ... the work of an astute and skilled artist". But he was not an easy man to get along with; and he was vociferously intolerant of supposed inefficiency amongst shore or depot ship staff. Long coded

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[1]The two external tubes amidships on the original T class design were positioned to fire forward, thus offering a massive ten tube bow salvo.

messages, which had to be laboriously decyphered by hand in the wardroom, were a particular bugbear when he considered that their sense could have been conveyed in markedly fewer words: "a perfect example of cypher diarrhoea", he growled.

If Linton sometimes seemed unduly tetchy it has to be remembered that he was nearing middle age; that much detail devolved personally on the captain in an RN boat with half the number of qualified officers available in a U.S.N. fleet submarine; and that operational routine was arduous—three weeks at sea followed by less than two weeks in harbour.

Fortunately, TURBULENT was blessed with a top notch First Lieutenant (Exec) in Tony Troup who left before the final patrol and later became FOSM and a Vice Admiral. Troup recalls that his captain became increasingly upset about the amount of bad language used on board; once, before sailing, he announced that there was to be NO SWEARING. Shortly after the boat dived the Engine Room Artificer at the panel dropped a wheelspanner on his sandalled foot. Obediently, he confined himself to "bother, bother, bother". Overhearing this unaccustomed example of restraint Linton popped out of his cabin and shouted, "Right, one good (*FOUR LETTER*) all round and THAT'S IT!"

Linton was not averse to being a father figure. He was continually offering advice to all and sundry, evidently without it being resented—quite the contrary according to Miers:

> "He was the most patient and lucid of teachers. Whatever I may have achieved myself I ascribe almost entirely to the time and trouble he took to indoctrinate me—albeit modestly—on my arrival in the Mediterranean [in TORBAY, April 1941]."

It is arguable that the First Flotilla boats, TURBULENT amongst them, were not employed to best advantage. The little U class submarines of the Tenth Flotilla at Malta, disposing amongst themselves some 30 torpedo tubes in all on average, and always needing reinforcements, were repeatedly flung against the main Axis supply lines to North Africa—to good effect, albeit at a heavy price; but the larger and faster T boats and S boats from Alexandria, with 80 tubes between them, were mostly sent to less distant and relatively unimportant areas, such as the Aegean, where targets

were usually less strategically important and often trivial. It has been suggested that C-in-C Mediterranean, Admiral Cunningham (who disliked submariners for their reprehensible habits of dressing casually and neglecting naval niceties), did not recognise the worth of submarines operating as an independent arm, away from the surface fleet.[2]

In any event TURBULENT's early sinkings were in the main confined to minor victims, and the gun was much in use. Several opportunities that presented themselves for torpedo fire—small merchant vessels and two U-boats—were missed; but there was plenty of excitement, and from the late Spring of 1942 (possibly because of help from ULTRA intelligence which led to large prey and clues about target speeds) TURBULENT began to score more heavily with her fish.

On 18 May TURBULENT was on the surface at night off Benghazi when Linton sighted a convoy of two ships escorted by a destroyer. He slipped astern of them and shadowed to check their speed and zigzag pattern before drawing ahead to a beam position and turning into fire. It then became clear that the group was further off than he had estimated (on the German side Dönitz was forever reminding his U-boat commanders that a ship in the dark always looks closer than it really is) and he patiently started all over again. At the second attempt he was well within range; and two out of the three torpedoes struck the 2385 ton BOLSENA. The Italian escort was commendably quick to counterattack, and TURBULENT dived in a hurry—but with the upper hatch refusing to shut properly. When the boat was able to surface Linton had to use one of the practical but smaller guntower hatches: "The designers of this hatch", he complained, can not have visualised its rapid use by a CO of fairly advanced years who had not retained the slim figure of his early youth."

During the still but intermittently misty night of 28 May TURBULENT, after failing to intercept three ULTRA-reported convoys, was on the surface charging batteries when at 2200 flares blazed into the moonlit sky not far away. An hour later lookouts briefly sighted the dim shapes of two ships accompanied by a pair

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[2]Author's conversations with Vice Admiral Sir Ian McGeoch; and p. 273 of *War Beneath the Sea* by Peter Padfield (John Murray, 1995).

of destroyers. Visibility at sea level was continually shutting down without warning although the moon was bright overhead. Precious torpedoes would be wasted unless the mean course and speed (within about 20 degrees and 2 knots) and, in due course, an aiming point could be established.

Linton decided to shadow, steal ahead, and hope to fire if and when moonlight or daylight broke through mist. He was an optimistic planner; and his hopes were fulfilled. By 0330 he had worked into a position five miles ahead of the convoy where he dived at an estimated 3000 yards off its mean line of advance—copybook stuff. Seven minutes later he altered course on to what he calculated would be the firing track. Assuming a convoy speed of 10 knots, he then had ample time to manouevre into the best possible firing position at an economical no-feather three knots.

Periscope visibility now clamped, and sound conditions were bad. But Linton, sometimes criticised for not having the *sixth sense* that makes really great commanders, held on: he had faith in his own judgement.

He was justified. Although for a long quarter of an hour he could neither see nor hear anything, he was finally able to distinguish two blurred shapes which could only be the merchant ships. They had undoubtedly zigged towards and he thought they were nearer than anticipated; but in fact they were nearly spot on the mean track he estimated, and probably about two miles away—just right!

This meant that TURBULENT would be firing a bow salvo from close range in eight minutes from that time. There was no sign of the escort; but four minutes later a destroyer materialised out of the mist, and after another two minutes its bearing had not changed. It was therefore on a collision course, and very close. But the DA for the leading target would not come on for yet another two minutes (oh, for American and German angling gear on the tubes!) and by that time...

Linton did not waver. Asdic bearings were far from dependable: only periscope aiming would ensure one or more hits. Slowly, dreadfully slowly, the merchantman slid toward the crosswire. When, thankfully, Linton gave the order to fire from the perfectionist's 1200 yards "the destroyer looked revolting, and occupied the entire periscope". Taking TURBULENT deep in a

hurry the captain and, doubtless, the entire control room team were "extremely relieved to see 40 feet on the gauge and know we were safe from being rammed". [Depths were measured from the surface waterline, not from the keel: thus 40 feet implied that the top of the periscope standards would have been eight or ten feet below the keel of a destroyer.]

The four-fish salvo had been spread to cover both ships. One torpedo sank the 3172 ton CAPO ARMO and another, running wide and circling noisily over TURBULENT sent the troublesome large destroyer IMMANIULE PESSAGNO to the bottom while "repenting of the fright it had caused". A third fish may have damaged the other ship in convoy. Not surprisingly, the Italian counterattack petered out.

By and large, though, Tubby Linton was not *lucky*. Fate was apt to intervene unkindly...blotting out a convoy with a rainstorm at the critical moment, for instance. It is true that fortune favors the brave, but not on a limitless basis; and Linton pushed his luck relentlessly for nearly three years of war. However, his dedication was not always appreciated by the crew: when he refused a day or so in harbour at Malta, which the program would have allowed, it was hard to reconcile his reasoning that it was "useless to be anywhere but at sea while the war is on: there are no targets here".

All the same, men were proud to be *Turbulents'*; and a few discovered that their captain was subject to some human frailties. In a rare burst of confidence, Linton asked the First Lieutenant if he got crinkles in his fingernails after a depth charging: "I get them", he admitted, "it's because you're scared stiff." Nobody cared to examine his nails; but perceptive observers noted that if he twisted black strands of his beard between thumb and forefinger it was a sign that he was a trifle anxious.

He looked for humor, too. After being spotted submerged by an aircraft before he could approach a convoy—sheer bad luck—the consequent depth charges did a lot of damage, but: "the noise appeared to excite the amorous instincts of the rats. Throughout the afternoon there were shrill screams of satisfaction behind the three-ply above my bunk."

Tasks assigned to TURBULENT included the landing of secret agents and shore bombardment. But why did Cunningham direct an expensive submarine, designed for attacking unseen, to come to the surface and pour a smallish flock of not very destructive four

inch shells on to an enemy factory or a railway line or (hard to believe) a car park? Close inshore on the eighth patrol TURBULENT ran on to some wreckage—which emphasised the undue risks: Linton had to extricate the boat by diving out astern which Tony Troup, an expert trimmer, managed perfectly. (In British boats the First Lieutenant was responsible for the trim. Long afterwards, Captain Tony Troup—steadfastly supportive, like his former master, of juniors of whom he considered worthwhile—teased some of us by demanding similar action when *working up* a newly commissioned boat).

TURBULENT destroyed a dozen merchant ships, a destroyer, and a number of small craft besides damaging several other vessels before succumbing to a mine[3] off Maddalena, Sardinia on about 17 March 1943. It was TURBULENT's 11th and Linton's 21st war patrol. If TURBULENT had returned safely to harbour, after spending 254 days of her last year at sea and surviving 250 depth charges during 13 anti-submarine hunts, she would have gone back to UK for refit.

Commander J.W. Linton, DSO, DSC was posthumously awarded the Victoria Cross in May 1943. The citation concludes: *"His many and brilliant successes were due to his constant activity and skill, and the daring which never failed him when there was an enemy to be attacked."* ■

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[3]Two-thirds of British submarine losses in WWII were due to mines. It was thought that TURBULENT might have been sunk by TETI II, one of three Italian anti-submarine trawlers and a launch reacting to an unsuccessful submarine attack on the 450 GRT mail ship PRINCIPESSA MAFALDA eight miles off Bastia on 11 March; but the claimed discovery of the submarine's wreck off Maddalena seems to prove otherwise.

LOSS OF GRUNION POSSIBLY EXPLAINED

by CDR John D. Alden, USN(Ret.)

The standard references to U.S. submarine losses during World War II characterize the fate of USS GRUNION (SS 216) as "an unsolved mystery".[1] A new boat under the command of Lieutenant Commander Mannert L. Abele, the submarine left Pearl Harbor on her first patrol on 30 June 1942 for patrol in Aleutian Island waters. On 15 July, Commander Abele reported firing three torpedoes at a destroyer without success. In a later message he claimed sinking three destroyer-type ships that same day. (Postwar records identified his victims as the 460 ton submarine chasers CH-25 and CH-27. The third ship, CH-26, in a message intercepted and decrypted by the U.S. code breakers, reported finding no survivors of her sister ships.) On 28 July Commander Abele reported firing two more torpedoes at unidentified ships off Kiska, again without hits. His final radio message, received on 30 July 1942, reported heavy anti-submarine activity at the entrance to Kiska harbor. With ten torpedoes left, GRUNION was ordered to return to Dutch Harbor but was never heard from again.

The late K. Jack Bauer concluded that GRUNION must have been the submarine reported sunk by the Japanese I-25.[2] However, it was later determined that I-25 actually torpedoed the Soviet submarine L-16 on 11 October 1942 in the belief that it was an American boat.[3] The incident was hushed up by all parties because of the delicate international situation where the Soviet Union was receiving lend-lease material from the U.S. via the northern Pacific route for use against Japan's allies in Europe, but was not at war with Japan.

Postwar records of Japanese shipping losses identified the 8572 ton ship KASHIMA MARU as having been damaged by a submarine 12 miles northeast of Kiska on 31 July 1942.[4] The official Joint Army-Navy Assessment Committee identified this ship as KANO MARU sunk 8 August by U.S. surface ships and Army aircraft.[5] A later and more detailed Japanese source stated that KASHIMA MARU was earlier named KANO MARU and had been torpedoed by GRUNION on 21 July, beached and subsequently shelled by U.S. cruisers on 7 August, and finished off by aircraft the next day.[6] Since GRUNION had been heard from as late as 30

July, this attack did not appear directly associated with the submarine's loss.

Japanese documents translated by Mr. W.G. Somerville of Lincolnshire, England, shed new light on the case. Although the information was published by Vernon J. Miller in the British Journal Warships in the 1980s, to the best of his and my knowledge it received no mention elsewhere in the U.S. The story is as follows.

The transport KANO MARU, formerly named KASHIMA MARU, was attacked three times on 31 (not 21) July, presumably by GRUNION. One hit was scored in the first attack, the second missed, and two torpedoes hit in the third salvo but were duds. The submarine then surfaced and was taken under fire by the transport's forward 80mm gun. At least one hit was claimed from 84 shells fired, and the submarine sank.[1] The disabled ship was towed into Kiska harbor on 2 August and unloaded. On 15 August it was further damaged by U.S. aircraft but remained afloat until beached and abandoned on 22 September.

It is reasonable to speculate that Commander Abele, frustrated by the failure of his torpedoes, decided to surface and finish off the damaged ship with his deck gun, not realizing that his intended victim was still well armed. Faced with a hail of 80mm shells, he probably *pulled the plug* in a hurry. The boat could have received a fatal hit, or it could have suffered a diving casualty during its hasty submergence. In any case, KANO MARU's account clarifies the confusing earlier records and offers a credible explanation for the loss of GRUNION.■

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U.S. NAVY TORPEDOES
Part Eight: Torpedoes in the Cold War

by Frederick J. Milford

When WWII ended, various reviews showed that U.S. Navy torpedoes had made a major contribution to winning the war in the Pacific. U.S. forces had sunk more than 90 percent of the Japanese ships lost during the war and torpedoes had been involved in over half of these sinkings. Most of the problems with straight running torpedoes had been solved and three new homing torpedoes had been tried in combat. One of these was a successful air launched anti-submarine weapon, one an anti-escort weapon, and the third a 21 inch, 20 knot/4000 yard anti-surface vessel torpedo. All that, however, was the past. Was there a post war threat and, if so, what was it? The answer had begun to emerge during the war as an increasing fraction of the military/foreign policy community came to view the Soviet Union as the most probable and most dangerous post war enemy. An early post war milestone was the so-called *long telegram* sent by George F. Kennan, who was then chargé d'affair at the Moscow Embassy, to the State Department on 22 February 1946. The crux of the message can be conveyed in a fragment from the first sentence of Part V: "...we have here a political force [the Soviet Union] committed fanatically to the belief that with U.S. there can be no permanent modus vivendi...". The telegram was widely read; James Forrestal had copies distributed within the Navy and it seems probable that most flag officers read it. If there had been doubt before, there was no doubt after the telegram—the threat was the Soviet Union.

The emergence of the Soviet threat and concurrent demobilization produced conflict, turmoil and confusion in the U.S. defense establishment. It was, nonetheless, clear that one of the prime naval threats was the already large Soviet submarine fleet and its potential for growth and improvement based on captured German materiel. From this it followed that ASW should be a major mission of the U.S. Navy. Given the composition and relatively small size of the Soviet surface Navy, fewer than 150 significant surface combatants, and the lack of dependence of the Soviet economy on sea borne commerce, anti-surface vessel operations seemed less important. Weapons, including torpedoes, developed

during WWII were judged to be adequate. In subsequent developments missiles became the anti-surface vessel weapon of choice, making torpedoes relatively less important for this purpose.

It is interesting to note that the Soviet Navy apparently viewed the situation in substantially the same way and concluded that because of NATO's large surface fleet and dependence on sea borne trade that naval surface vessels, particularly Carrier Task Forces, Amphibious Task Forces, and merchantmen should be the principal targets for their submarines. As a result, they produced a large variety of increasingly sophisticated and increasingly lethal anti-surface vessel torpedoes in the four decades following WWII.

The importance of ASW was formally recognized in June 1946, when the Chief of Naval Operations, Fleet Admiral Chester W. Nimitz, initiated Project GIRDER, a major research and development project with the objective of dramatically improving ASW. Research and development in ASW has remained important ever since and, in fact, it was the Navy's top R&D priority until the spring of 1950. GIRDER embraced surface, air, and somewhat wishfully, submarine based ASW. New and improved platforms, sensors, weapons and doctrine were sought. Our interest here is on part of that spectrum, the role of torpedoes primarily as post WWII ASW weapons, and we will focus rather narrowly on that subject.

ASW Torpedoes 1945-1958

The initial post WWII submarine threat estimate was 100 to 150 modern Soviet sea-going submarines. There were forecasts that this could grow to the order of 300 by 1950. These estimates include at least four Type XXI boats and the possibility of 20 more. U.S. Navy WWII ASW systems were moderately effective against the S and SHCH classes but could not deal with the Type XXI part of the threat. The Type XXI was rated at 17.18 knots for one hour and in U.S. trials made 15.2 knots for 1.2 hours. Furthermore, the Whisky class of Soviet submarines was under development and began service in 1950. While not as capable as the Type XXI, it was a serious challenge to early post WWII anti-submarine forces.

The dominant U.S. ASW forces were destroyer type vessels and aircraft, both carrier and land based. Homing torpedoes, Mk 24

and later Mk 35, largely displaced depth charges and bombs as the principal airborne ASW weapons. These torpedoes were replaced by Mk 43 (ca 1951), Mk 44 (ca 1957) and later (ca 1963) Mk 46. The initial emphasis for surface vessel ASW was continued use of WWII weapons, improved forward thrown weapons and improved sonar. High speed, deep diving homing torpedoes were desired, but in the immediate post war years, they were far from adequately developed. Around 1950 the Mk 32 active homing torpedo was resurrected and put into production as a surface vessel ASW weapon. These torpedoes were launched over the side by a launcher reminiscent of those used in PT boats. This was probably the first homing torpedo in service use on U.S. ASW surface vessels.[1] At about the same time, the Mk 35 torpedo finally entered service. It was carried by destroyers equipped with fixed 21 inch tubes, usually in the after deckhouse or on the O-1 level, and by submarines. Twenty-one inch tubes of various kinds were also used for launching Mk 35, Mk 37 and Mk 48 torpedoes from surface vessels without much real success. Currently the only surface vessel ASW torpedo in use is the Mk 46 launched from Mk 32 tubes.

The Submarine Force was initially left out of both ASW and strike warfare, the two major Navy missions and relegated to a fleet warning and protection role. This situation changed rather quickly. Submarines became an important part of strategic warfare, with SSGs and eventually SSBNs as platforms for long range missiles. SSKs and SSNs, improved sonar, new ASW torpedoes and new tactics led to a major role in ASW. The starting point was, however, inauspicious. As of August 1945 all of the submarines that operated in both Allied and Axis navies had sunk 20 German and 9 other submarines during WWI and 83, including 20 Japanese and one U.S. Navy, submarines during WWII. Almost all of the submarines were surfaced and attacked by

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[1]The Mk 32 was carried by many destroyer type vessels. It had no runout and executed a helical search. Though it had a ceiling switch, it sometimes, fortunately with exercise heads, attacked and dented the launching destroyer. It was not a popular weapon. I have, so far, found no substantive comment about its effectiveness. There are occasional reports that Mk 24 torpedoes were launched from destroyers in tests, but I have not been able to verify these reports.

submarines that were either surfaced or at periscope depth. Thus most of these attacks were, in essence, attacks against surface targets that happened to be submarines. The exception was HMS VENTURER's attack on U-864 while both were submerged to periscope depth. This remains the only known actual sinking of a submerged submarine by another submerged submarine. As of the end of WWII, there were no submarine launched weapons for use against submarines submerged below periscope depth.[2] Furthermore, the involvement of submarines in ASW was opposed by the surface and aviation ASW communities and even by some of the submariners. Early post war submarine conferences did, however, discuss submarine based ASW and recognized several concomitant needs including new acoustic homing torpedoes.[3] One result of these conferences was the establishment by the CNO of Project KAYO, which permitted the submarine service to organize "to solve the problems of using submarines to detect and destroy enemy submarines." Perhaps the most significant response was the establishment of SubDevGroup Two, which combined scientific talent and operational submarines to tackle ASW problems. The first postulated submarine target was an eight knot, cavitating snorkeler. Since their depth was known (fixed by the snorkel), such targets were vulnerable to conventional straight running, set depth torpedoes (Mk 14 or Mk 16) or to the late WWII Mk 28 homing torpedo. The first true anti-submarine homing torpedo to

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[2]This as opposed to surface vessel armament including depth charges, hedgehogs and air launched depth charges, depth bombs and homing torpedoes all of which were intended for use against submerged submarines. The submarine launched anti-submarine/anti-surface vessel Mk 33 was under development at the end of the war and 30 were produced for test and evaluation. Mk 35 development, incorporating some Mk 33 technology began in early 1945.

[3]The early history of submarine vs. Submarine warfare is discussed in an excellent paper by Frank Andrews "Submarine vs. Submarine", in Frank Uhlig, Jr., editor, "1966 Naval Review", Annapolis, MD: U.S. Naval Institute, 1965, pp. 42-57. Additional material appears in Frank Andrews "The Evolution of SubDev Group Two", THE SUBMARINE REVIEW, April 1983 pp. 4-17. Captain Andrews' papers contain a great deal of interesting information about how submarine based ASW evolved in the U.S. Navy and handsomely reward careful reading.

enter service with U.S. Navy submarines was the passive homing Mk 27 Mod 4, which began service with the fleet in 1949. This torpedo, with its 15.9 knot speed and homing in both depth and azimuth, was potentially effective against fully submerged early post war Soviet diesel submarines operating at speeds up to about 10 knots. Its performance in exercises against tame targets was encouraging. The Mk 27-4 was soon joined by the faster, 27 knot, but enormously complicated and expensive, passive/active homing Mk 35. Both remained in service into the early 1960s. About 4000 Mk 27-4s were produced and it was carried as part of the loadout by most submarines. Successes with the Mk 27-4 encouraged the development of the 26 knot Mk 37. The Mk 37, which entered service in 1956, was designed against the threat of Soviet diesel submarines with some classes capable of 16 knots submerged. The number of these submarines grew from under 200 to around 350 boats while the torpedo was being developed. In this role it was an effective counterthreat. The first Soviet submarine launched, homing anti-submarine torpedo, SET-53, did not enter service until 1958 at the earliest. This timing is consistent with a Soviet strategy of building a large submarine fleet while largely ignoring ASW.

ASW Torpedoes Since 1958

In September 1954, even before Mk 37 was issued to the fleet, USS NAUTILUS (SSN 571), was commissioned. The performance of NAUTILUS was nothing short of revolutionary. Further, in 1954 the Soviet military press began to discuss nuclear power including ship propulsion. The prospect of Soviet submarines with performance comparable to that of NAUTILUS put U.S. Navy ASW back to a position comparable to 1945 ASW with the threat Type XXI submarines. The new threat was highly maneuverable submarines with effectively unlimited submerged endurance at speeds in excess of 20 knots (23.3 knots for NAUTILUS). Existing U.S. ASW weapons were ineffective against NAUTILUS. It is sometimes said, not unreasonably, that nuclear powered submarines wiped out 10 years of ASW research and development. The Soviet threat materialized in 1958 when the first Project 627 (NATO November class) submarine (SSN) was completed. The November class, though noisy, was credited with 28-30 knots

submerged, a speed then matched[4] by only one service torpedo, the air launched Mk 44. In 1959 the first Soviet Project 658 (Hotel class) SSBN was completed. This development further exacerbated the ASW problem by requiring not only screening against SSNs, but also detection and tracking of stealthy SSBN targets. Strategic ASW had been born.

Airborne ASW since 1958 has involved fixed wing land based, fixed wing carrier based, and rotary wing aircraft. Fixed wing aircraft have been fitted with sonobuoys and magnetic airborne detection (MAD) gear. Rotary wing aircraft have carried sonobuoys and more recently dipping active sonar. The primary ASW weapon has been the lightweight homing torpedo. In 1957 the 30 knot Mk 44 began to replace the much slower Mk 34 and Mk 43 aerial torpedoes. Thirty knots is adequate for attacking 20 knot targets including most of the 1948 Soviet submarine fleet, but essentially ineffective against 30 knot targets, in particular the November class.[5] The U.S. Navy established a panel of distinguished civilian experts to study, among other submarine issues, anti-nuclear submarine warfare. This study, known as the NOBSKA study, concluded that the only possibilities were effective 45 knot homing torpedoes or nuclear weapons (torpedoes, bombs, depth charges or missiles) that could be detonated close to enemy submarines. The high speed homing torpedo posed serious problems. It was not until 1966, more than 10 years after the NOBSKA study, that the 45 knot Mk 46 homing torpedo began replacing the Mk 44. Aircraft again had a reasonable chance of killing 30 knot submarines. The comparable submarine launched torpedo, the 55 knot Mk 48, did not begin to enter service until 1972. This balance was, however, precarious and from the U.S. viewpoint tilted the wrong way when the 45 knot Soviet Project 705 (Alpha class) submarines appeared. This class had a checkered

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[4]Matching speed is not enough. A reasonable kill probability requires a torpedo speed approximately 1.5 times the target speed.

[5]The Soviet nuclear submarine fleet grew rather quickly. Some estimates indicate that completions by the end of 1963 included 13 November class SSNs, 8 Hotel class SSBNs, 5 Echo I class SSGNs and 7 Echo II class SSGN. Other, probably less reliable, estimates, of about the same vintage, give different numbers.

history,[6] but the threat, though ultimately short lived, was real. A 45 knot submarine requires a 65 knot homing torpedo as an effective countermeasure. The U.S. Navy response was the 65 knot Mk 48 ADCAP and 50+ knot Mk 50. As it turned out, subsequent Russian submarines have been slower, under 35 knots, but quieter. The Mk 50 was not procured in quantity and the Mk 46 remains the primary airborne ASW weapon. The current state of this cat and mouse game is quite properly classified.

Surface vessel torpedo ASW had much in common with airborne torpedo ASW. Although the Mk 2 torpedo launching system with the Mk 32 and other torpedoes persisted for a time, in 1958 the Mk 32 torpedo tube, often in trainable triple tube nests, and the Mk 44 torpedo became the premier ASW weapons of destroyer type vessels. The problems were identical to those encountered with air launched torpedoes, mainly the Mk 44 was too slow to deal with 30 knot submarines. In due course the Mk 44 torpedoes were replaced by Mk 46 torpedoes launched from the Mk 32 torpedo tubes. The same tubes could also accommodate the Mk 50 torpedo, but it seems probable that none of these were issued to surface vessels for other than test firings.

There have been other surface vessel ASW torpedo launching systems including GREBE, RAT and ASROC all of which launched torpedoes, as payloads of missiles, into aerial trajectories. In this way it was possible to achieve large standoff distance and short deadtime. Of these, only ASROC became operational. It was a rocket launching system with a payload consisting of either a lightweight torpedo or a nuclear depth charge. The maximum range was 10,000 yards. The IOC for ASROC was 1960. It could be launched from box launchers or from some railed launchers on destroyers and cruisers. The nuclear version of ASROC was withdrawn from service in 1989 and the torpedo carrying version in the early 1990s.

Submarine based ASW suffered the same ignominious setbacks as other forms of ASW. Diesel submarines even with the new Mk 37 torpedoes were no match for targets capable of sustained

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[6]Only seven were built. One was scraped early on and another may have suffered the same fate. There are reports that the remaining five are in reserve as an economy measure.

submerged speeds in excess of 22 knots. The NOBSKA study's conclusion that either nuclear warheads or much faster homing torpedoes were needed was also valid in submarine versus submarine engagements. There was, however, another consideration; the attacking submarine needed at least as much submerged speed and stealth as the target to get within and maintain torpedo range.[7] It became apparent[8] that the nuclear powered submarine threat required both nuclear powered ASW platforms and new torpedoes to counter it. The new submarine launched torpedoes were the Mk 45 heavyweight with a nuclear warhead (IOC 1960 approximately); the Mk 48 heavyweight (IOC 1972); and the Mk 48 ADCAP (IOC 1989). Here too the driver was the Soviet submarine threat, which included about 100 nuclear powered submarines of all classes. Heavyweight torpedo development seems to have lagged badly behind the submarine threat.[9] Even since the end of the Cold War the silent conflict of submarine versus submarine has continued. At the present time this conflict seems likely to continue, though

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[7]This is an oversimplication. Sonar ranges and acoustic signatures of the two submarines are also important. The radiated sound level from U.S. nuclear submarines decreased rapidly as new classes emerged providing a significant advantage with roughly the same speed capability. An unclassified comparison of U.S. and Soviet broad band sound radiation appears in Tom Stefanik "Strategic Antisubmarine Warfare and Naval Strategy", Lexington, MA: Lexington Books, 1987, p. 274.

[8]At least it became apparent to many submarine COs. Vice Admiral George Steele, then a Commander commanding USS SEADRAGON (SSN 584), wrote a paper in *Proceedings of the Naval Institute* (November 1960) entitled "Killing Nuclear Powered Submarines." The main theme of this paper was that an SSN was the best ASW platform against other SSNs. In a few years this view came to dominate, but ComSubLant, ComASWPac and many of the submarine flag community were critical of the paper when it appeared. I am much indebted to Admiral Steele for his comments and insight.

[9]The Mk 48 began life as the EX-10 in 1957. It took seven years to reach the project definition phase in 1964 and another eight before IOC in 1972. There were serious technical problems, but there were also political problems. The full story may rival the TFX and C5A stories as a case study in weapon system acquisition.

at a slower pace and with further changes in platforms and weapons.

Some current uses for torpedoes do not fall neatly into any of the categories we have used. One of these is the use of lightweight torpedoes as the payload for the CAPTOR (Mk 66) mine. CAPTOR is a moored, deep water ASW mine that detects and evaluates passing targets. Appropriate targets are attacked by launching a Mk 46 Mod 4 torpedo upward. Another application is the conversion of Mk 37 torpedoes to Mk 67 mines. The Mk 67 mine is submarine launched and self propelled for remote planting.

Torpedoes are still important submarine weapons, though perhaps no longer totally dominant. They now compete with self propelled mines, tube launched missiles and vertical launch systems. Further, torpedoes themselves will continue to change, the Russians already have the jet propelled, *SHKVAL* reportedly capable of 200 knots. A Tomahawk launched torpedo has been proposed. There is a crying need for anti-torpedo defense and for this purpose short range, high speed torpedoes may be the best solution. The most significant current U.S. programs appear to be directed towards simplifying the inventory. The Light Weight Hybrid Torpedo is one step in that direction. U.S. torpedo program funding (total procurement and R&D) has declined from over $500M in FY96 to a requested $119.8M for FY98 and about $140M for FY99. However, "Forecasting is difficult, especially when you try to do it for the future" so I'll leave that to the courageous cadre who undertake such tasks.

The first of these eight articles appeared in the April 1996 issue of **THE SUBMARINE REVIEW**. They seem to have already provoked a significant amount of discussion and I hope it will continue. Torpedoes in the U.S. Navy have a fascinating history. They represent a microcosm of advanced technology. They played a major role in WWII. In addition to technical difficulties torpedoes have demonstrated most of the managerial and bureaucratic problems to which a weapon system can be subjected. A few of the lessons that seem apparent to me are:

- Weapons are the tools of the operating forces. Feedback as to operational performance must not only be accepted, but actively sought and used to eliminate defects and improve the performance of weapons.

- Inbreeding is very dangerous. It can lead to omissions and commissions and these produce faults and defects that are both difficult and embarrassing to rectify. The critical design review, among other tools, is aimed at avoiding such problems. To be effective the review must be independent and rigorous. The entire U.S. torpedo program from 1922 through 1941 suffered from this problem.
- Weapons must be tested, again independently, but also in as nearly as possible combat situations. Such testing is admittedly very expensive, but not testing can be even more expensive. Pre-WWII torpedoes were inadequately tested. Critical defects turned up in the Mk 10, Mk 13, Mk 14 and Mk 15 torpedoes and the Mk 6 exploder years after they were issued to the fleet or, in the case of the Mk 6 exploder, declared ready for issue. WWII homing torpedoes might also have benefitted from further testing. This criticism must, however, be muted because getting homing torpedoes into use during WWII, especially against submarines and escort vessels was critically important. The time from the beginning of development to first combat firing for these torpedoes was less than 18 months. Furthermore, early use in combat probably should be considered as operational testing. The crucial question is, are current production torpedoes being adequately tested?[10]
- The risk of trying to do too much too soon must be recognized. Technical risk analysis must be particularly rigorous. Careful examination from many perspectives is crucial. Validating a single analysis is not enough. The Mk 6 magnetic influence exploder and the Mk 35 torpedo were striking examples of this sort of problem.

This is by no means either a particularly original or comprehensive list. These points have been made before and there are no other points or examples. What they have in common is that they all involve asking hard questions. There are now management tools for finding many of the hard questions and there are people who

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[10]See Captain Ralph Enos "The Trouble with Torpedoes", THE SUBMARINE REVIEW, October 1997, p. 51.

seemingly instinctively ask these hard questions. Both should be used rather than subverted or ignored. All this is well known to good program managers. Sometimes, however, even well known lessons are overlooked or must be learned again.

Acknowledgments

This series of eight articles is now finished and I would like to acknowledge the generous help that I have received from many people. It is impossible to cite all of these individuals and I apologize for oversights. I have had constant help, advice and encouragement from Richard J. Boyle, David E. Cohen, Captain Thomas D. Grimm, USN(Ret.), Thomas J. Pelick, Rear Admiral Maurice H. Rindskopf, USN(Ret.), Rod Rupert and Douglas A. Shireman all of whom are good friends and who contributed more than they know. With respect to specific points and issues Captain Frank Andrews, USN(Ret.), Captain Charles Bishop, USN(Ret.), Professor Harvey Brooks, Captain Harry Caldwell, USN(Ret.) Admiral I.J. Gallantin, USN(Ret.), Professor M. Gannon, Professor R. Gannon, Rear Admiral Jeffrey Metzger, USN(Ret.), Dr. Robert Plummer, Vice Admiral George P. Steele, USN(Ret.), also good friends, have generously contributed their expertise. NARA archivists especially Marjorie Ciarelli and Barry Zerby and the Upper Arlington Public Library librarians especially Christina Brawner; and Pam Lingbloom and Barbara Moe at the Naval Undersea Museum in Keyport provided important assistance in locating reference materials. Finally, our outstanding editor Captain James C. Hay, USN(Ret.) has been enormously helpful and a constant source of encouragement. As usual none of these is in any way responsible for errors of omission or commission which are mine alone.■

A Persuasive Argument, 1904

"My beloved submarines are not only going to make it damned hot for the enemy...but they are going to bring the income tax down to threepence in the pound."

(Admiral Jack Fisher, 1904)

IN SUPPORT OF TWO-CREW SSNs

by LT Stuart Rosner, USN

In response to Lieutenant Gittleman's article in the October 1997 issue of **THE SUBMARINE REVIEW**, I emphatically agree that we should shift to two-crew SSNs. I am a submarine junior officer who has just completed a three year tour on the USS Portsmouth (SSN-707) and is now stationed at the Nuclear Power Training Unit at Charleston, South Carolina. I most likely will leave the Navy after my two-year tour at NPTU. However, if I knew that our SSNs were switching over to the French-style two-crew SSN rotation outlined in Lieutenant Gittleman's article, I would become a *career man* without hesitation. The bottom line as to why I will probably get out is the relentless nature of the one-crew SSN operational schedule.

For me, it is not the extended periods of time away from homeport that makes the SSN schedule seem relentless. I thoroughly enjoyed my time at sea, whether it was local operations off Southern California or forward deployment in the western Pacific. What makes the SSN schedule seem relentless is the massive amount of work SSN crews do in port in between the at-sea periods. Besides a stand-down after a deployment and a short stand-down during the winter holidays, the only respite SSN crews receive between at-sea periods are intense upkeeps with their long working hours and frequent duty days. It would be hard to exaggerate the boost in an SSN's crew's morale if they were guaranteed a significant block of time within the operational cycle during which the crew did not *have the boat* and could concentrate on getting some rest and catching up with family. For me, it would be enough of a boost to keep me in the Navy for another sea tour.

For those that think the above reason for going to two-crew SSNs is just another case of a Generation X submariner whining, there is another convincing reason to switch over to two-crew SSNs—training. Too often during my sea tour we just paid lip service to the submarining ideal of making training our top priority when we were in port. Because of the intensity of our upkeeps the prevailing attitude towards training nearly always became "we'll squeeze training in" on this day or "we'll fit in an attack center" on that day. Needless to say, this is not the right way to approach

training. If SSNs had a significant block of time during their operating cycle during which the only objective was to train, the training would be infinitely more effective because the distractions of an intense upkeep would be gone.

The other factor that would boost training effectiveness is that the SSN *off-crew* would be able to utilize the Submarine Training Facility to its utmost potential. During my sea tour, the times we sent personnel up to SubTraFac to learn or hone a skill, whether it was a small skill such as periscope observations or an involved team skill such as VLF(A) tracking, I was impressed by the facilities and expertise that SubTraFac had to offer. Almost immediately, the benefits of this shore training became apparent in the way we did business. The problem was that we did not take advantage of SubTraFac as much as we should have due to the pressures of our upkeep schedule.

As far as proficiency goes, if the off-crew uses its training period effectively, proficiency will suffer very little. There is a lot of truth to the axiom that the only way to maintain proficiency is to be at sea, but any rustiness that the off-crew may have accumulated will be canceled out by the fact that when the off-crew returns to sea, they will be well-rested, happier, and more knowledgeable.

If the Submarine Force is to drop down to 50 SSNs in the near future while continuing at present tasking levels, it just makes too much sense to go to two-crew SSNs. Everybody wins: morale will skyrocket, and consequently so will retention. Training effectiveness will improve dramatically, making SSNs more formidable than ever. In his article, Lieutenant Gittleman proved that the Navy will save money and get more sea time by going to two-crew SSNs. As for me personally, going two-crew SSN will be what prevents me from returning to civilian life, and I believe there are a lot of other submariners who feel the same way. SSBNs have used the two-crew system with tremendous success. We submariners should follow that lead if we want to make the most out of a 50 SSN force.■

DEVELOPING REAL ANTI-DIESEL TACTICS

by LT Jack Shriver, USN
Combat Systems Officer
USS ASHEVILLE (SSN 758)

The Problem

We as a Navy have a significant problem with developing effective tactics to counter the Second and Third World diesel submarine (henceforth *diesel boat*) threat in the littorals. Though I speak from a submariner's perspective, this is as true for the surface and air community as it is for the submarine community. There are two main difficulties in solving this problem, the environment of the littorals and the targets themselves. The focus of this paper is on the latter, the modern diesel boat threat.

There is a huge standard deviation of capability amongst our potential diesel boat adversaries, making tactics development a tricky business. There have been ongoing efforts to rectify the situation, through exercises and computer modeling, but none have developed what we need: clear guidance that, given some discernable input parameters, will give us a tried and true set of tactics to apply with confidence in a given situation.

One cause of our lack of confidence against diesel boats is a lack of experience. We have all, either in exercises against our own, or during operations against others, searched out and tracked nuclear submarines for decades. We have also tried, over the last few years, to conduct exercises in which one of our SSNs simulates a diesel boat. Though this may satisfy the most basic level of introductory level training, it falls short of the mark for the professional training upon which mission success may depend. For example, how do we know if we would have been counterdetected during a certain maneuver? We know whether or not our SSN-cum-SS counterdetected us, but is that realistic enough to depend upon in a real situation? Most submariners don't think so. We get much more valuable experience against real diesel boats during exercises with our allies, but they are not at our beck and call. We cannot conduct the necessary detailed, repeated, controlled testing of tactics, sensors, and especially weapons, against them.

Another problem we face with anti-diesel tactics is a lack of the requisite perspective. To better fight an enemy, one must be able

to understand his capabilities, limitations, and priorities, but very few of us have ever served on a small diesel boat. Even against those most similar to us, with modern sonar, a towed array, long life batteries, and USW torpedoes, our starting assumptions are very different. Our missions, sensors, weapons capabilities and loadout, crew size, training level, propulsion, electrical power, C4I, and atmospheric controls differences all add up to a completely foreign set of priorities and mindset.

The Solution

To overcome our lack of experience and perspective, we need a new solution. We must create an *aggressor* unit, the mission of which would be to portray, as accurately as possible, the capabilities of those diesel submarine forces about which we are most concerned. This aggressor unit must operate on one of the those submarines of concern, preferably a Kilo or Type 209. It's time for the U.S. Navy to build or buy one or more of these submarines. They are, after all, available on the open market. How many should we acquire? We should start with just one, assigned to DEVRON 12, for tactics development. If the concept proved workable, we should expand to two per coast, in Groton, Norfolk, San Diego and Pearl Harbor. This would provide on demand, realistic anti-diesel training services for the major SSN bases, surface fleets, and USW patrol squadrons.

Costs

It is not the intent of this paper to conduct a detailed feasibility study, but we may discuss the costs and benefits in a general sense. First and most obvious, the submarine itself will cost a significant amount. Though detailed costs were not available, estimates range from $100 to $200 million dollars, depending on the type of boat, the equipment installed, the maintenance support required, etc. There are also options that would allow U.S. shipyards to manufacture foreign designs under license. This option is also relevant to maintenance costs, and the availability of spare parts. The cost of maintenance should be fairly low, when compared to our nuclear boats. The cost of operating, on the other hand, might be higher, given fuel consumption and battery depletion. A detailed study by

acquisition experts would reveal the most cost effective arrangement, but it is safe to say that, as far as submarines are concerned, these would not be expensive boats.

If this concept proves workable, one can foresee that the services of this boat would be in very high demand, from not only the SSN community but the surface and air communities as well. This high OPTEMPO would strain the crew, but we have solved that problem before. There may need to be two crews per boat, at least until sufficient boats were available to meet all of the demands. This is not as heavy a cost as one might imagine, however, since the crew size would be less than half that of a SSN crew.

Another cost would be crew training. The Intelligence Community would need to provide the necessary input for training the crews on enemy tactics periodically. Crew members would need to have an aggressive exchange program with allied diesel boat navies, to gain a feel for how they operate, so as to better simulate our adversaries. Technical training on the operation and maintenance of the new equipment would have to come from the manufacturers, which would not be inexpensive, but may be able to be wrapped into the purchase and maintenance deal.

Benefits

The most obvious benefit of this idea is tactics development. We would have the capability to run unlimited planned geometries and freeplays against an actual diesel boat, using actual threat diesel boat parameters. We could debrief the aggressor crew, which would be trained to think like the enemy, not like us. Currently this can only be done on deployment, a single wardroom at a time, trying to develop tactics and test them against an ally during valuable exercise time. Obviously we would not want to curb these exercises with our allies, but the focus of a pre-trained SSN could be more on tactic verification and practice than on development.

The same applies for weapons and sensor testing. I doubt that many of our allies would allow us to engage their small diesel boats with Mk 48 or even Mk 46 exercise torpedoes. With an aggressor boat, we could verify that our weapons and sensors work against a target with the actual acoustic values, counterdetection

capabilities, and evasion capabilities we can expect.

As was mentioned above, there is a lack of diesel boat perspective in our wardrooms. With one or two of these aggressor boats, we would develop a corps of extremely experienced personnel. As these personnel rolled back onto the fleet, this experience would become part of wardrooms (and sonar shacks) everywhere. Not only that, but whenever the aggressor boat goes to sea to provide target service, personnel from the opposing SSN (or DD, or VP, etc.) could cross-deck to the diesel boat, gain personal experience, and also debrief their own crew on lessons learned. An aggressor crewmember cross-decked to the opposing platform could provide real time training during the exercise, the inputs like "this threat likes to hide in areas like this one", or "he'll snorkel within the next two hours", or even, "yes, that's what his torpedo tubes sound like, you're in trouble now."

One of these aggressor boats in each of the above ports would take a tremendous load off the SSNs in the fleet. As a dedicated, non-deploying *rabbit* most if not all of the diesel boat services required from our SSNs could be turned over to them. This would free up the rest of our fleet for more dedicated independent steaming time, or more inport time. Our deploying SSNs and battlegroups could be trained and certified for deployment against the aggressor unit, simulating diesel boats of threat countries in the area of the deployment.

Finally, the addition of these boats to the fleet will create more CO and XO billets. It may not be the command of a nuclear submarine for which we are all striving, but it beats unemployment by a long shot. Given its small crew size, and non-deploying, not-really-a-warship status, it is even conceivable to give command of an aggressor unit to *hot-running*, third sea tour submariners, who could skip their XO tour, and get two opportunities for command.

Variables

One of the difficulties in trying to develop tactics against Second and Third World diesel boats is the huge variation in the quality of their subs, their missions, and their crew proficiency. The tactics used by a highly proficient, quiet, USW capable Kilo submarine are completely different from those used by a 25 year old Romeo with a crew that rarely goes to sea, and which carries

only USW torpedoes. These variables can only be mastered and simulated by a dedicated aggressor boat and crew, and even then it might not be possible with only one type of boat with one equipment loadout. This begs the question: "What type of boat should we get, and what equipment?" The answer is: buy the best, and install calibrated degradations to simulate down to the worst.

A well trained aggressor crew will be able to simulate different conditions of proficiency by making more or less noise, or reacting quickly or slowly, but there are limits. For example, if your top-of-the-line sonar display shows a contact, but you are supposed to simulate a less powerful sonar set, is that a realistic simulation? Probably not. The advantage of having a dedicated aggressor boat is that one could buy the top-of-the-line equipment, and then install variable degradation settings on the equipment (keeping ship's safety in mind, of course) that would simulate less capable suites. An OPORD might read "simulate country A Kilo with moderate crew proficiency, type X sonar, type Y ESM, and type Z weapons." This would tell the aggressor boat what tactics and crew response delays times to use, and what pieces of equipment in what degradation modes.

This opens another question. Should we buy threat weapons, and modify them for exercise use? If so, what types should we buy? There are many more types of torpedoes on the market than submarines. For starters, the weapon selection, procurement, and modification process seems to fall into the *not worth the trouble* category. If the program proves to be successful, but it is found that exercise weapons are needed, then perhaps this should be reconsidered, but not as an initial investment.

As the greatest potential threat to our naval forces, don't diesel submarines deserve the greatest efforts of tactics, sensors, and weapons development? Why have we gone on so long using only simulations and computer modeling when the real item is available on the open market? This seems to be a second rate effort. When our battlegroups and SSNs deploy, don't they deserve to be trained against the closest we can get to the threat they may actually face? The time is ripe to create a realistic aggressor SS program, staffed with dedicated personnel, and equipped with the real thing.■

The Submarine Centennial Commemoratives Survey

The Submarine Centennial Memorabilia Committee is seeking your ideas and suggestions for commemorative items in connection with the Submarine Centennial. Specifically, the Committee is looking at three categories of items: (1) Inexpensive "giveaways" such as bookmarks, pins, bumper stickers, etc.; (2) Items that would be sold such as coffee cups, baseball caps, flags, coasters, cocktail glasses, cards, etc.; and (3) A permanent Submarine Centennial "leave behind", i.e., a memorial, plaque, painting, statue, sculpture, time capsule, display or similar item that would be a permanent commemoration of the Centennial. All suggestions will be considered carefully to determine appropriateness, cost vs. interest, ability to execute, etc. Please send your ideas to the Naval Submarine League. If appropriate, please include points of contact and any supporting information.

Name_____ Phone _____

(1) Inexpensive commemorative items suggested for consideration as "giveaways":

Item	Description

(2) Commemorative items suggested for consideration as items to be sold:

Items	Description

(3) Suggestions for a permanent Submarine Centennial "leave behind":

Location	Description

REUNIONS

USS JOHN C. CALHOUN (SSBN 630)
July 30-August 2, 1998, Charleston, SC.
Contact: Peter Swiderski, 3704 Lighthouse Way
Holiday, FL 34691 (813) 844-0630
E-mail: petemk47@gte.net

USS THOMAS JEFFERSON (SSBN 618)
August 13-16, 1998, Ramada Inn, Norwich, CT.
Contact: Paul Wm. Orstad, 30 Surey Lane
Norwich, CT 06360-6541 (860) 889-4750
(860) 433-3972 (fax)

USS REQUIN (SS/SSR 481)
September 18-21, 1998, Pittsburgh, PA.
Contact: Robert Garlock, 207 S. 7th Street
McConnellsburg, PA 17233

USS SEADRAGON (SS 584)
September 9, 1998, Hagerstown, MD.
Contact: Larry Yano, 8528 Bauer Drive
Springfield, VA 22152 (703) 913-0565
E-mail: lyano@circ.ha.osd.mil

USS SIRAGO (SS 485)
September 10-12, 1998, Hagerstown, MD.
Contact: William Gerber, 344 Blueridge Drive
Levittown, PA 19057-3024 (215) 946-3907
E-mail: Sirago-GERB-SS-485@prodigy.com

USS TRITON (SSRN/SSN 586)
June 26-28, 1998 , Mystic, CT.
Contact: Ralph A. Kennedy, 89 Laurelwood
Road, Groton, CT 06340 (860) 445-6567.

WHATEVER BECAME OF THE *THIRD OFFICER*?

By CAPT James H. Patton, Jr., USN(Ret.)

Before the local format was changed a bit awhile back, the Naval Submarine League sponsored a small afternoon reception for each graduating SOBC and SOAC class at Sub School, and a member was asked to mix with the group and say a few words about the NSL. As an underemployed retiree, I was often asked to provide that pleasant service, and as a result, over the period of perhaps 10 years, got to chat with most of these submariners.

A question I almost invariably asked the SOACs was whether or not they were going to be the *Third* on their next boat—almost invariably resulting in a puzzled look and perhaps a "Do you mean Senior Watch Officer?" question in return. I then characteristically pontificated a bit too much about the difference, but I think the imbedded message was and is an important one.

The Senior Watch Officer is just that—the senior member of the wardroom who stands watches. His most essential task is, once a month, to prepare an in-port officers watch bill which is then (on most ships I'm afraid), modified and approved by the XO, or even (on some ships, unfortunately), modified and chopped on by the XO and then passed to the CO for further modification and final approval.

The Third Officer, on the other hand, is the wardroom Chief-of-the-Boat. He, not the XO (or God forbid, the CO!) is the one who tells a JO that he needs a haircut or that his uniforms are shoddy. He, not the XO, is who gets the officers out of bed for field days, and goes to the XO's stateroom 3-4 minutes before a scheduled lecture to let him know that he can tell the CO that everyone is ready. When the Third submits a watch bill, any subsequent review or approval is perfunctory, and because of that, any officer junior to him would almost rather aggravate the CO than the Third.

In our profession at least, sea stories are an indispensable part of the teaching/learning process, and the following relates to the current issue. On an SSN in 1970, the renowned, respected and highly decorated skipper was shortly being relieved, and chose to host a wardroom party at his home to thank his officers and introduce the new skipper to them. One bachelor Lieutenant didn't show, not having sent any *regrets* or the like, and the following

Monday the Third was summoned to the COs stateroom:

"(angrily)Why didn't (John Doe) come to my party Saturday night!?"

" I don't know Cap'n, but I'll find out."

"John, how come you didn't go to the Skipper's party?"

"I had other things to do."

"Cap'n, John had other things to do" (pause as CO fumes) "Do you want me to take care of it, Sir?"

"Yes!"

The ship had spent some 300 days at sea, mostly deployed, during the preceding year, and was due to be in port for a month before the change of command. On the watch bill that was due and promulgated a few days later, John Doe had been assigned the Saturday duty for all five weekends.

"You can't do this to me!"

"I just did."

"I'm going to talk to the Captain about it!"

"Be my guest."

When John left the CO's stateroom after about a 30 minute closed door session, he was significantly humbled and, thereafter, a model of social and professional etiquette. He did, by the way, stand the 5 Saturday watches—a hollow action being worse than no action at all.

All of this is about something far more important than power struggles or ego trips for the Third/Senior Watch Officer. It's about training—the Third is, in the normal course of things, an XO under instruction, and the more he learns and acts (under observation) about running the wardroom and its officers, the better XO he will be. Of even greater importance, the more the Third picks up the load from the XO in such matters, the more time the XO will have to spend on his real job—an under-instruction CO. Synergistically, the XO will then be able to pick up the load from the real CO in enough areas that the Skipper can spend more time on his real job—the morale and fighting ability of his ship and crew, and the only person on the ship who doesn't have to spend a significant portion of his time making himself better prepared for his next job.

There is no real *requirement*, of course, to pass responsibility down but still retain accountability, but in this instance, the alternative could easily be that the CO does the XO's job, the XO does what the Third should be doing, Department Heads act as

Division Officers, and Division Officers try to be LPOs—a job for which the best of them are (and we *elders* were) woefully inadequate. Meanwhile, the Chiefs take refuge in the Goat Locker to rightfully grumble, and the rest of the crew become short-timers. Not only isn't that a formula for winning the 'E', but the odds aren't bad that the ship will run aground or worse. Having the XO be CDO every night, from the start of the ritualistic 2000 wardroom movie (which the skipper **always** attends) until the CO chooses to awaken is a far less risky affair, and also builds a better ship and a stronger Force.■

DIRECTORY ADDRESSES

Due to a glitch in our new database program, the following addresses were missing from the 1998 Directory when it was printed in October.

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7609 Dublin Drive
Manassas, VA 20109-3354

TMC(SS) Richard K. Sparger, USN(Ret.)
194 Tall Pines Road
Ladson, SC 29456

SUBMERGE BACKING DOWN

by CAPT Gordon W. Enquist, USN(Ret.)

In September 1955 I rode SEA LEOPARD (SS 483) for a week of type training in the Virginia Capes Operating Areas—the underway part of my submarine qualification examination. Monday I was snapped in on SEA LEOPARD's procedures, got the boat underway, was OOD out the channel, compensated and made the trim dive; routine functions with no drills thrown in. Next morning, Tuesday, I stood by on the bridge awaiting the real tests with some apprehension.

The skipper, Commander Robert L.J. Long, joined me on the bridge and asked if I'd ever submerged backing down. Surprised that he would even ask, I said, "Yes, sir; many times."

"I didn't say, 'Backed down submerged,' " he said patiently, "I said, 'Submerged backing down'."

I did a double take, saw that he wasn't joking, and said, "No, sir."

The captain said, "Neither have I. Let's try it."

Thoughts of what to do filled my head, but he hadn't finished: "After we get sternway I'll drop down to the conning tower; when I order the dive I'll see that the helmsman holds the rudder amidships and rings up *all back full* rather than ahead full. Think about the boat's attitude: negative tank is going to give you an immediate bow-down angle; you'll have to deal with that. I'll order 80 feet; that should give you some leeway in leveling off. Ready? Back her down."

The sea was lovely with no waves, just one of those long gentle swells so often seen in the summer off the Virginia Capes. At about six knots sternway the captain called up the hatch, "Submerge."

I yelled, "BLOW NEGATIVE", as I held the upper hatch shut; even so when I hit the diving stand I could feel the bow-down attitude. With full dive on both planes, backing full, and negative at the mark SEA LEOPARD still clung stubbornly, interminably, to the surface. Finally, the angle shifted aft. I called for a two-thirds backing bell. Suddenly the angle, sluggish for so long, began running. And once started, how it ran!

The inclinometer bubbles quickly vanished; the pendulum inclinometer was swinging at an alarming rate.

"All stop; all ahead full. Blow the after group."

There was a rush of 600 pound air. The air manifold operator reported, "Blowing the after group."

The chief of the watch on the hydraulic manifold, urgently intense, was saying, "Sir! The main vents are open!"

"Secure the blow." I was straining to retain the professional *sang froid* of the crew around me. What a boat! Everyone in the control room was silent except as their jobs required, holding onto whatever was available to keep their feet. The only disturbance was a crash of dishes in the crew's mess and the duty cook's hastily subdued cussing. I was balanced with my right foot on the deck and my left on the bulkhead behind the conning tower ladder. The depth gauges were rotating fast. I saw the pendulum inclinometer hit 43 degrees by the stern as we passed 200 feet.

A quiet voice from above said, "Everything all right, Lefty?"

Executive Officer Lieutenant Commander Lionel (Lefty) Goulet, similarly balanced behind me (he hadn't uttered a word to that moment), answered in the same calm manner, "OK here, Captain."

And indeed everything was all right. The angle was easing, the planesmen were getting control.

"All stop; all back two-thirds." So, in reverse, we planed placidly up to where I was able to report, "Eight zero feet, conn."

I was astonished when the captain called down, "Well done."

Later, in the wardroom, Lefty reviewed the morning exercises. When he addressed the backing down dive, he said, "There were several good lessons in the dive. In particular, when we lost the bubble, the diving officer used his head and blew the after group with the vents open. That put enough air in the tanks to help check the angle, but almost immediately vented off. As unstable as the boat was with sternway we probably would have broached had venting been delayed."

If my face was red it wasn't from modesty. Here's the background on what had happened:

In 1955 the submarine procedures manual was being updated and standardized in SUBLANT. In COBBLER (SS 344), the boat I was trained in, the chief of the watch automatically shut the main vents when passing 40 feet on a dive; SEA LEOPARD's chief of the watch, except at the diving alarm, only shut or opened the main vents on order from the diving officer. Blowing main ballast with the vents open hadn't been a matter of being smart; in the excite-

ment I'd forgotten the (to me) unfamiliar SEA LEOPARD procedure, then compounded the error by not checking the Christmas tree before ordering the blow.

I've always suspected that Lefty knew I'd forgotten those damn vents. It's too late to ask, but it would have been in that gentleman's character to give a young squirt the benefit of the doubt—knowing that the lessons were perhaps even more effective when swallowed with a dose of guilt.■

U.S. Naval Cryptologic Veterans Association
REUNION

Washington, DC
16-19 September 1998

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SOME DATA POINTS FOR THE MILLENNIUM

by EMCS/SS Jim Christley, USN(Ret.)

As we approach the millennium, we also approach the 100th anniversary of the U.S. Naval Submarine Force. This anniversary is dated from both April 11, 1900 when the Navy bought its first modern submarine, and 11 October 1900, the commissioning date for USS HOLLAND. She is the first of an unbroken line of commissioned submarines that have served our country. (The first submarine the U.S. Navy owned, however, was taken into service on 13 June 1862 and made one wartime deployment.) Only cruisers, as an existing commissioned ship type have a longer history. It is fitting that we look at some of the numbers and milestones. These, then, are a few data points for this anniversary.

We have laid down 678 hulls; of these, we have commissioned 663 (if the yet unnamed SSN 23 is commissioned by 1 October 2000). This number includes U-3008 or U-2513 which were taken into service and commissioned, but does not include NR-1 which is not commissioned. To classify the types of submarines by their propulsion method, 22 used gasoline engine/electric motor, 448 used diesel engine/electric motor, 191 use nuclear propulsion plants and one used hydrogen peroxide. The number of attack submarines remaining in commission as of 1 October 2000 will be approximately 50. The oldest submarine still in commission will most likely be USS DOLPHIN (SS 555) and the oldest nuclear submarine still in service is, and will be for some time to come, NR-1. The oldest nuclear submarine in commission will pass quickly from boat to boat as we decrease fleet size.

The operational capabilities of our Force can be conveniently looked at by dividing our history into a beginning, mid-point and today: 1900, 1950 and 2000. The most advanced submarine of 1900 was the Holland class, of 1950 was the Tench class (Tangs weren't commissioned until 1951 and after), and today is the Seawolf class. A Tench with the Guppy II conversion could travel as fast submerged as a Holland could travel on the surface. Seawolf's submerged maximum speed is said to be nearly twice as fast while submerged as the Tench class was on the surface. The Hollands could engage a single target at a range of about 1000 yards. A Tench could engage multiple targets (in convoy) at a

range approaching 10,000 yards. The Seawolf can engage multiple targets at a range of 100 miles with missiles (or nearly 1000 miles with Tomahawks)! The fleet ballistic submarines of the Ohio class can engage entire countries at a range of 4000 miles.

U.S. submarines have taken an active role in three major wars. A submarine goes on patrol wherein often, but not always, the boat acts as an independent or semi-independent warship. These patrols may be offensive, defensive, surveillance, barrier, strategic deterrent or special operations. The first documented sortie of the Submarine Force for deployment under wartime conditions was in August 1913 in Manila Bay, RPI. Since then the Force has amassed the following totals: WWI patrols, 157; WWII patrols, 1693. Classification considerations have effectively halted all historic research on any submarine operational history after 1945, however, there are 15 Cold War patrols unclassified and available for researchers. During the period of the Cold War (1946 to 1991) we have made at least 3500 strategic deterrent patrols and an unknown number of surveillance and barrier patrols. In addition, during the major campaigns in this war, Korea and Viet Nam for example, we have made many offensive, defensive and special operations patrols. During the Gulf War, we made offensive patrols in the war zone and took an active part in hositilities. We have come a long way, but at a prodigious cost.

In these wars, many awards and honors have been bestowed on submariners or on men who serviced the boats. In the 100 year history of the Submarine Force, 14 members of the Force and its support force have received the highest medal awarded by the United States for courage and bravery. Seven were awarded to officers for gallantry in wartime. These recipients are Captain John Cromwell, Commander Samuel Dealey, Commander Eugene Fluckey, Commander Richard O'Kane, Commander Howard Gilmore, Commander Lawson Ramage, and Commander George Street. One Medal of Honor was awarded to an enlisted crewman. Torpedoman Henry Berault of USS O-5 was awarded the medal for his heroic actions in the sinking of that vessel in 1923. Six Medals of Honor were awarded to men who risked their lives in efforts to save the crews of submarines. These men are: GMC Frank Crilley, TM1 John Mihalowski, GM1 Watler E. Harman, MMC William Badders, GMC Thomas Eadie, BMC Orson L. Crandall.

The standard number that comes to the mind of many, and

indeed the public, of submarine losses in the U.S. Navy is 52. This figure comes from a document published after World War II entitled Submarine Report, Depth Charge, Bomb, Mine, Torpedo, and Gunfire Damage including Losses in Action.[1] In this report are listed the 52 submarines lost during the period 7 December 1941 to 15 August 1945. This list of 52 has been memorialized by the Submarine Veterans of WWII and in the years since the end of the war, has become the standard answer to how many boats were lost. The listing includes those boats lost with the loss of all hands, with some survivors, with all the crew as survivors, boats scuttled, and boats abandoned. However, for the entire history of the Force, the list is longer. In fact, using the criteria of the WWII list, we have lost 66 submarines. And an additional six have been lost while in the service of foreign navies and four have been lost due to special circumstances. This gives a total of 76 submarines built by and commissioned in the U.S. Navy which have been lost to service. This is over 10 percent of the submarines we have commissioned.

The following is a list of those submarines lost during the 100 year history of the Force.

Category I—Lost with all hands (45 submarines)

USS F-4 (SS 21) was lost on 21 March 1915 with the loss of 19 officers and men when it foundered off Honolulu Harbor.

USS S-4 (SS 109) was lost on 17 December 1927 with the loss of 34 officers and men when it was sunk after ramming by USCG PAULDING.

USS O-9 (SS 70) was lost on 20 June 1941 with the loss of 34 officers and men when it foundered off Isle of Shoals, 15 miles from Portsmouth, NH, 42°-59'-48"N, 70°-20'-27"W.

USS S-26 (SS 131) was lost on 24 January 1942 with the loss of 46 officers and men when it was sunk after ramming by USS PC-460 in the Gulf of Panama, 14 miles west of San Jose Light.

USS SHARK (SS 174) was lost on 11 February 1942 with the loss of 59 officers and men when it was sunk East of Menado, Celebes as a result of one of three attacks. (11Feb42 E of Menado,

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[1]Preliminary Design Branch, Bureau of Ships, War Damage Report No. 58.

17Feb42 N of Kendari, 21Feb42 E of Kendari)

USS GRUNION (SS 216) was lost on 1 August 1942 with the loss of 70 officers and men when it was sunk near entrance to Kiska (Alaska) Harbor. *(Ed. Note: See article by CDR Alden in this issue.)*

USS ARGONAUT (SS 166) was lost on 10 January 1943 with the loss of 84 officers and men when it was sunk off Rabaul near 05 155N 153 50E; (another location given as 5° 40S 152° 02E).

USS AMBERJACK (SS 219) was lost on 16 February 1943 with the loss of 72 officers and men when it was sunk off Rabaul; last contact at 5° 05S 152° 37E.

USS GRAMPUS (SS 207) was lost on 5 March 1943 with the loss of 72 officers and men when it was sunk in the Blackett Strait; possibly in Vella Gulf, last contacts at 4° 55S 152° 30E.

USS TRITON (SS 201) was lost on 15 March 1943 with the loss of 74 officers and men when it was sunk at 0° 09N 144° 55 E.

USS PICKEREL (SS 177) was lost on 3 April 1943 with the loss of 74 officers and men when it was sunk within lume of Shiramuka Light off Honshu (aka Shiranuka Light).

USS R-12 (SS 89) was lost on 12 June 1943 with the loss of 42 officers and men when it foundered off Key West, 24° 24'30"N 81° 28'30".

USS RUNNER (SS 275) was lost on 1 July 1943 with the loss of 78 officers and men when it was sunk somewhere between Midway and Hokkaido.

USS PAMPANO (SS 181) was lost on 1 September 1943 with the loss of 76 officers and men when it was sunk off the northeast coast of Honshu.

USS GRAYLING (SS 209) was lost on 9 September 1943 with the loss of 76 officers and men when it was sunk in or near Tablas Strait, PI.

USS CISCO (SS 290) was lost on 28 September 1943 with the loss of 76 officers and men when it was sunk in Sulu Sea west of Mindinao, 9° 47N, 121° 44E.

USS WAHOO (SS 238) was lost on 11 October 1943 with the loss of 79 officers and men when it was sunk in or near La Perouse Strait.

USS DORADO (SS 248) was lost on 12 October 1943 with the loss of 78 officers and men when it was sunk in Western Atlantic, possibly near Cuba.

USS CORVINA (SS 226) was lost on 16 November 1943 with the loss of 82 officers and men when it was sunk south of Truk (attack at 151° 10E 5° 50N).

USS CAPELIN (SS 289) was lost on 1 December 1943 with the loss of 76 officers and men when it was sunk off Celebes possibly off Kaoe Bay; Halmahera 1° 34N 123° 07 or in Molukka Passage.

USS SCORPION (SS 278) was lost on 1 February 1944 with the loss of 77 officers and men when it was sunk East China Sea.

USS GRAYBACK (SS 208) was lost on 26 February 1944 with the loss of 80 officers and men when it was sunk near 25° 47N 128° 45E.

USS TROUT (SS 202) was lost on 29 February 1944 with the loss of 79 officers and men when it was sunk near 22° 40N, 131° 45E, middle of Phillippines Basin.

USS GUDGEON (SS 211) was lost on 12 May 1944 with the loss of 80 officers and men when it was sunk off Saipan near Maug Island.

USS HERRING (SS 233) was lost on 1 June 1944 with the loss of 80 officers and men when it was sunk within shore battery range of Point Tagan, Matsuwa Island, in Kurlies.

USS S-28 (SS 133) was lost on 4 June 1944 with the loss of 50 officers and men when it foundered off Hawaii, while operating with USCGC RELIANCE.

USS GOLET (SS 360) was lost on 14 June 1944 with the loss of 82 officers and men when it was sunk near 41° 04N 14° 13E.

USS GROWLER (SS 215) was lost on 8 July 1944 with the loss of 84 officers and men when it was sunk in South China Sea.

USS ROBALO (SS 273) was lost on 26 July 1944 with the loss of 84 officers and men when it was sunk 2 miles off west coast of Palawan.

USS HARDER (SS 257) was lost on 24 August 1944 with the loss of 80 officers and men when it was sunk off Caiman Point near Bataan.

USS ESCOLAR (SS 294) was lost on 1 October 1944 with the loss of 82 officers and men when it was sunk somewhere east of 33-44N 127-33E; heading for 33° 44N 124° 06E.

USS SHARK (SS 314) was lost on 24 October 1944 with the loss of 90 officers and men when it was sunk in channel midway between Hainan and Bashi Channel; 20° 41N 118° 27E.

USS SEAWOLF (SS 197) was lost on 30 October 1944 with

the loss of 102 officers and men when it was sunk just north of Morotai, between PI and Indonesia, by USS ROWELL; 02°-32N 129° 18E.

USS ALBACORE (SS 218) was lost on 7 November 1944 with the loss of 86 officers and men when it was sunk near 41° 49N 141° 11E in channel between Hokkaido and Honshu.

USS SCAMP (SS 277) was lost on 16 November 1944 with the loss of 83 officers and men when it was sunk off Inubo Saki near Tokyo Bay.

USS BARBEL (SS 316) was lost on 4 February 1945 with the loss of 81 officers and men when it was sunk in southern entrance to Palawan Passage 7° 49.5S — 116° 47.5 SW Palawan

USS SWORDFISH (SS 193) was lost on 15 February 1945 with the loss of 90 officers and men when it was sunk near Yaku Island off Kyushu, water <600 feet deep near island; (27° 00N; 128° 40E).

USS KETE (SS 369) was lost on 1 March 1945 with the loss of 87 officers and men when it was sunk somewhere between 29° 38N 130° 02E and Midway.

USS TRIGGER (SS 237) was lost on 28 March 1945 with the loss of 91 officers and men when it was sunk in area 32° 16N to 30° 40N by 132° 05E to 127° 50E, (maybe near 32° 16 N 132° 05E).

USS SNOOK (SS 279) was lost on 8 Aril 1945 with the loss of 84 officers and men when it was sunk within 100 miles east of 18 40N 111 39E, near Hainan Island <300 feet.

USS LAGARTO (SS 371) was lost on 30 May 1945 with the loss of 88 officers and men when it was sunk off Malay Coast in or near the Gulf of Siam 7° 55N 102° 00E.

USS BONEFISH (SS 223) was lost on 18 June 1945 with the loss of 86 officers and men when it was sunk in Toyama Wan; near Suzu Misaki; 37° 18 N 137° 25E.

USS BULLHEAD (SS 332) was lost on 6 August 1945 with the loss of 84 officers and men when it was sunk in west end of Lombok Strait.

USS THRESHER (SSN 593) was lost on 10 April 1963 with the loss of 129 officers and men when it sunk while on sea trials near Isle of Shoals.

USS SCORPION (SSN 589) was lost on 27 May 1968 with the loss of 99 officers and men when it sunk while in transit from

Med, west of Azores.

Category 2—Lost with some of the crew as survivors (14 submarines)

USS F-1 (SS 20) was lost on 17 December 1917 with the loss of 19 officers and men when it sunk after collision with F-3 off San Clemente.

USS H-1 (SS 28) was lost on 12 March 1920 with the loss of 4 officers and men when it grounded, Magdelena Bay, Mexico; sunk in 9 fathoms while being towed off.

USS O-5 (SS 66) was lost on 11 October 1923 with the loss of 2 officers and men when it sunk after collision with SS ABAB-GAREZ (United Fruit) off Panama Canal.

USS S-51 (SS 162) was lost on 25 September 1925 with the loss of 32 officers and men when it sunk after collision with SS CITY OF ROME off Block Island.

USS SQUALUS (SS 192) was lost on 23 May 1939 with the loss of 26 officers and men when it flooded and sank off Portsmouth, NH.

USS SEALION (SS 195) was lost on 10 December 1941 with the loss of 5 officers and men when it was scuttled in Manila Bay after damage at Cavite.

USS PERCH (SS 176) was lost on 3 March 1942 with the loss of 8 officers and men when it was sunk near 30 miles NW Soerabia, Java. (60 officers and men were taken prisoner, 52 survived the war.)

USS GRENADIER (SS 210) was lost on 22 April 1943 with the loss of 4 officers and men when it was sunk near Penang, 10 miles west of Lem Voalan Strait. (61 officers and men were taken prisoner, 57 survived the war.)

USS S-44 (SS 155) was lost on 7 October 1943 with the loss of 56 officers and men when it was sunk on fifth patrol off Paramushiru, Kuriles (Northern); one day out of Attu. (2 men were taken prisoner, both survived the war.)

USS SCULPIN (SS 191) was lost on 19 November 1943 with the loss of 40 officers and men when it was sunk north of Groluk Island near Truk. (42 officers and men were taken prisoner, only 21 survived the war.)

USS TULLIBEE (SS 284) was lost on 26 March 1944 with the

loss of 79 officers and men when it was sunk in operating area just north of Palau. (1 man was taken prisoner and he survived the war.)

USS FLIER (SS 250) was lost on 13 September 1944 with the loss of 80 officers and men when it was sunk in Balabac Strait near Mantagule Island. (8 of the crew were taken prisoner, all survived the war.)

USS TANG (SS 306) was lost on 25 October 1944 with the loss of 83 officers and men when it was sunk in north end of Formosa Strait in vicinity of Turnabout Island. (9 of the crew were taken prisoner and survived the war.)

USS COCHINO (SS 345) was lost on 26 August 1949 when it sank in Norwegian Sea after fire, 1 man from COCHINO and 6 men from USS TUSK were lost in the rescue operation.

Category 3—Lost with all crew as survivors (7 submarines)

The Civil War submarine **ALLIGATOR** was lost in 1863 when it sank while under tow off Cape Hatteras. It was being towed south to aid Union efforts in forcing entrance into Charleston Harbor. The crew was on board the towing vessel.

USS S-5 (SS 110) was lost on 1 September 1920 when it foundered off Delaware Capes 40 miles offshore. All the crew escaped through a hole cut in hull in the tiller room.

USS S-36 (SS 141) was lost on 20 January 1942 when it was destroyed after grounding on Taka Bakang Reef in Makassar Strait, Indonesia, near Makassar City. The crew were all rescued.

USS S-27 (SS 132) was lost on 19 June 1942 when it grounded off Amchitka Island, 400 yards off island near St. Makarius Point (near Constantine Harbor). All the crew were rescued.

USS S-39 (SS 144) was lost on 1 August 1942 when it was destroyed after grounding on reef south of Rossel Island Louisande Archipelago. All the crew were rescued.

USS DARTER (SS 227) was lost on 24 October 1944 when it became grounded on Bombay Shoal off Palawan then was destroyed. All the crew were rescued by USS DACE.

USS STICKLEBACK (SS 415) was lost on 30 May 1958 when it sank off Hawaii while being towed, after collision with USS SILVERSTEIN (DE 534). All the crew were taken off prior to sinking.

Category 4—Lost while in foreign service (6 submarines)

USS S-25 (SS 130) was lost on 4 November 1941 with the loss of all hands when it was sunk by Allied escorts while on loan to Poland, off Norway.

USS R-19 (SS 96) was lost on 21 June 1942 with the loss of all hands when it was sunk after ramming by HMCS GEORGIAN while on lease to England.

USS BLOWER (SS 235) was lost with the loss of all hands when it was sunk in Dardanelles in collision with Swedish ship NABOLAND (as Turkish submarine).

USS DIABLO (SS 479) was lost with the loss of all hands when it was sunk in Bay of Bengal (as Pakistani submarine), possibly due to mine explosion.

USS CATFISH (SS 339) was lost on 1 July 1971 with the loss of an unknown number of officers and men when it was sunk (as Argentinian submarine SANTA FE) at South Georgia Island during Falkland War.

USS ATULE (SS 403) was lost with the loss of an unknown number of officers and men when it was sunk after ramming by a Japanese merchantman off Callao, Peru.

Category 5—Lost under special circumstances (4 submarines)

Ex-**USS G-2 (SS 22)** was lost on 30 July 1919 when it sank as a test vehicle for explosive tests. Sank with 3 men aboard in Two Tree Channel 1/4 mile off Pleasure Beach, CT; counted here due to loss of life.

USS BONEFISH (SS 582) was declared a functional loss after a fire in which 3 crewmen lost their lives.

USS NATHANIEL GREENE (SSBN 636) was reported decommissioned instead of repairing after grounding (to conform to SALT agreement).

USS SALMON (SS 182) was declared a constructive total loss after her last patrol due to severe damage and decommissioned on 24 September 1945.

[Note: this last category may be incomplete.]

Of the submarines lost during wartime (includes Cold War 1946-1991):

Two foundered: S-28 and R-12

Four were sunk accidently by friendly forces: SEAWOLF, F-1, DORADO, and S-26

Five were scuttled (four after grounding): SEALION, S-27, S-36, S-39 and DARTER

Forty-five were sunk by direct enemy action or from unknown or accidental causes: S-44, ARGONAUT, SHARK(I), PERCH, PICKEREL, POMPANO, SCULPIN, SWORDFISH, TRITON, TROUT, GRAMPUS, GRAYBACK, GRAYLING, GRENADIER, GUDGEON, GROWLER, GRUNION, ALBACORE, AMBERJACK, BONEFISH, CORVINA, HERRING, TRIGGER, WAHOO, FLIER, HARDER, ROBALO, RUNNER, SCAMP, SCORPION, SNOOK, TULLIBEE, CAPELIN, CISCO, ESCOLAR, TANG, SHARK(II), BARBEL, BULLHEAD, GOLET, KETE, LAGARTO, THRESHER, SCORPION, COCHINO.

The list above is only the list of the ships: the material part of the submarine equation. Sailing aboard submarines is a hazardous business. They operate in a hostile environment and do constant battle with the sea. On occasion, the sea wins. Sometimes all the crew dies, sometimes there are survivors. Many were lost during declared wartime when the sea is not the only enemy and sailing in harm's way is a way of life. Others were lost when the sea was the only declared enemy but the hazards of maintaining peace required the submarines to be put to sea. In the 100 year history of the Submarine Force, over 4000 shipmates have given the "last full measure of devotion." Most of the losses came in the years of World War II when we were in our second shooting war involving submarines. Unlike World War I, hundreds of boats went on patrol and many didn't come home. In the period from 7 December 1941 to 15 August 1945, just over 3500 men of the Submarine Force died in all manner of actions starting with the bombs that dropped on Cavite; subs sank, men were washed overboard, men were wounded or killed in gunfights with enemy vessels or aircraft, and some gave their lives to save their ships.

The first submarine to be lost was in peacetime operations. She was F-4 in 1915. Our first wartime casualty in a combat zone was in WWI when, on 24 January 1918, GM1 R.A. Leese went overboard and was lost from L-10 (SS 50) in the Eastern Atlantic. Over the long history of the Force, another 500 men died as a

result of accidents, sinkings, and hazards of the sea. This count does not even start to take into consideration those men who gave of themselves to such an extent that it cost them their health and then their lives. For some the pressures of the work, for whatever the reason, caused them to take their own lives. Some submariners died in the performance of their duty for the Force but not on submarines. Admiral English and his entire staff perished on a California hillside in a horrible plane crash in 1943. Fire fighters at Mare Island Shipyard gave their lives in the POMODON fire. In remembering the history of the Force, we must remember not only those whose names are engraved on WWII Memorial Walls.

The whole history is the tradition. The early submariners who survived the "green devil and fiery death" in the early boats with open battery cells and gasoline engines gave birth to the tradition of knowing the boat and trust in your shipmates. They taught the men who took little E boats and L boats across the Atlantic to search for German submarines in 1917 and 1918. These men made "on station, on time" the tradition. The men who tapped out "Please hurry" on the torpedo room hatch of S-4 gave us the impetus for a safer Submarine Force. World War II submarines showed the world what the United States Navy's Submarine Force was all about and we have never taken second place to any naval power since. In Korea, submarines were sent to watch and wait, watch and report; and they did. This tradition of the surveillance patrol was fine tuned over the 50 years of the Cold War. The hazard of getting caught was very real and we were very lucky. For many submariners, the tradition was doing a thankless job over and over on hundreds of thousands of watches on strategic deterrent patrols. The tradition lives on.

At times it may seem to some that the submarine tradition consists only of the time they were actively involved in sailing submarines, or to others only the WWII years. It is quite normal that we remember our years as the most difficult and most demanding. Those sea stories we share about how bad it was or how tough it was are a part of the tradition. However, we owe to our shipmates who went before us a recognition that if it weren't for their sacrifice, we might not have had as easy a career as we had. We also need to keep in mind that the job we leave to our successors could be every bit as hazardous as it was for us. It is only in this way, the tradition will live on.

The following submarines are either historic ships, in museums, as a museum ship or as a memorial:

BATFISH (SS 310)	Muscogee, OK
BECUNA (SS 319)	Philadelphia, PA
BLUEBACK (SS 581)	Portland, OR
BOWFIN (SS 287)	Pearl Harbor, HI
CAVALLA (SS 244)	Galveston, TX
CLAMAGORE (SS 343)	Charleston, SC
COBIA (SS 287)	Manitowoc, WI
COD (SS 224)	Cleveland, OH
CROAKER (SS 246)	Buffalo, NY
DRUM (SS 228)	Mobile, Al
INTELLIGENT WHALE	Washington Navy Yard
LING (SS 297)	Hackensack, NJ
LIONFISH (SS 298)	Fall River, MA
MARLIN (SST 2)	Omaha, NE
NAUTILUS (SSN 571)	Groton, CT
PAMPANITO (SS 383)	San Francisco, CA
REQUIN (SS 481)	Pittsburgh, PA
TORSK (SS 423)	Baltimore, MD
X-1	Annapolis, MD

Blue on Blue

"Frequent bombings of our submarines by 'friendly' aircraft had not impressed me with the earnest desire of the Army Air Force to co-operate with other forces."

(From Sink'em All by Vice Admiral Charles A. Lockwood, USN.)

Maxims of Max

"There is no margin for mistakes in submarines: you are either alive or dead ... it is not a kindness to overlook slackness of mistakes, it is really great cruelty to do so—cruelty to wives and relatives of the man you let off, and his shipmates and to yourself."

(Max Horton, Vice Admiral (Submarines), addressing 10th Flotilla submariners at Malta in September 1941.)

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TALK AT NROTC COMMISSIONING CEREMONY

Rensselaer Polytechnic Institute
Alumni House, 30 December 1997

by Warren H. Bruggeman
former VP of General Electric and
GM, Nuclear Energy Operations

Captain Woodman, honored guests, newly commissioned officers, ladies and gentlemen, good morning.

It is a pleasure to speak at the commissioning ceremony today and address the newly commissioned ensigns of the United States Navy. Each one of you enters the future with a real edge—a leg up. You've received a Rensselaer Polytechnic education—one with a reputation for turning out fine engineering and technical graduates—graduates with a *can do* reputation.

And with an added plus—an opportunity to serve your country as an officer in the United States Navy—a tour of duty in what I believe to be the finest military service in the world. You'll be working with, and leading, first class people. You'll have a greater responsibility at an earlier stage of your career, and you'll develop leadership skills and self assurance faster than you would otherwise. The RPI-Navy combination is indeed a real winner—be it a four year hitch or a full Navy career.

Having personally been exposed to this combination, albeit 52 years ago, I envy you the experience and opportunities that you'll face in the coming years. Old sailors like to tell sea stories, so if I indulge from time to time, I hope you'll understand. I joined the NROTC at RPI in 1943, during the war years. One of the pleasures was to undertake a four year Bachelor's curriculum compressed to 2-1/2 years, and the all-too-brief summer vacation periods were replaced by shipboard assignments on escort vessels, protecting tankers from U-boats on the Caribbean to New York City run.

I remember one cruise was aboard ST. AUGUSTINE—a converted luxury yacht owned by Barbara Hutton. The ROTC crew was outfitted in bell bottoms like the ship's crew—with one exception—our caps had a wide blue band around the brim. Pretty jazzy until we had liberty in Guantanamo Bay, and the word had already been passed by the *real* sailors to the local ladies that the blue piping identified those in the crew that had social diseases.

Not withstanding that, we had an uneventful return north. However, we speculated that with little in the way of compartmental bulkheads and watertight integrity, ST. AUGUSTINE, if torpedoed, would sink in about 90 seconds—a premonition unfortunately validated on the escort run a month after we were back at RPI.

Subsequent to my commissioning in early 1945, I was assigned to a new 2200 ton destroyer, USS PURDY (DD 734), that I picked up at Pearl. My billet was as navigator. I guess they figured a chem engineer was out of place in a ship's engine room. The war was over, but being navigator was exciting as we made courier runs all through the inland seas of Japan—an area very heavily mined by U.S. aircraft. After 10 or 12 hours on the bridge, the supposedly 500 yard paths the mine sweepers cleared became, or at least seemed, smaller and smaller. PURDY was the first U.S. naval vessel to make port in Hiroshima after the bomb had been dropped. The chance to observe, first hand, the nuclear age was most sobering to all on board.

After my discharge in 1945, I signed up with General Electric in Schenectady believing my association with the Navy to be at an end. But it was not to be. GE asked me to work with a group in Schenectady which was to become the Knolls Atomic Power Lab and which had the mission to develop, for U.S. Navy BuShips, a nuclear propulsion system for submarine application. That started a 23 year assignment that put me in close contact with both Navy and civilian personnel in BuShips, Electric Boat, naval architects and ships' crews and nuclear trainees. It was good to be home!

The BuShips program, which in a short span of years converted the U.S. submarine fleet to nuclear power, was a major undertaking. All submarines, up to 1946, were basically surface ships that were diesel powered. To submerge, the diesels were shut down and electric batteries powered the U-boats underwater, with submerged endurance limited to ½ hour at top speed or 12 hours at low speed. The submarines then had to resurface to recharge batteries from the diesels. Toward the end of WWII, the Germans fitted some of their submarines with a snorkel system—a large air intake tube, the height of the periscope, which sucked air in and allowed the diesels to be used at periscope depth. The snorkel provided much improved underwater range, but did leave a significant wake and severely limited the operating depth to a few

feet. As I was to find out on a cruise on a snorkel equipped boat, another feature was a clapper valve that shut the air supply when waves covered the snorkel tube. The diesels remained operable because they just sucked air from the submarine hull instead. The effect was an atmospheric pressure change inside the hull from sea level to 15,000 feet, in seconds, and back again. I personally considered the effect on the crew to be almost inhumane.

When offered the potential of nuclear power, the prospective COs and their crews were ecstatic—unlimited cruising, never having to surface except to take on food, making voyages from the Atlantic to Pacific Oceans under the polar ice cap, true underwater hull shapes like a guppy and not like a surface ship, and with diving planes located on the conning tower (or sail). I had numerous impromptu lectures from the PCO of SEAWOLF (SSN 575), Commander Dick Lanning. His eyes would light up and he was actually talking like a fighter pilot—sub vs. sub battles at 1000 feet, etc. The submarine sailors could hardly wait.

The remarkable program was launched in 1946, headed by BuShips with Electric Boat Division of General Dynamics as builder and Westinghouse as reactor designer. The first effort, USS NAUTILUS (SSN 571), was to be a high pressure, water cooled reactor with uranium fuel, clad with zirconium. A full size replica of the nuclear machinery was to be built at the nuclear test site in Idaho, and followed by the ship construction at Electric Boat—almost in parallel. There was serious speculation that the zirconium clad fuel rods would exhibit excessive corrosion by the water coolant and hence BuShips authorized a full blown backup to the pressurized water program. The GE backup effort was just as comprehensive. The coolant was metallic sodium that was liquid from 207 degrees to 1600 degrees Fahrenheit. It behaved well with the stainless clad reactor, but otherwise was nasty stuff. When exposed to air, liquid sodium burned vigorously; on contact with water it generated hydrogen and virtually exploded. My Westinghouse friends used to jest, saying if the oceans were made of sodium, GE would propose a water cooled reactor!

The water cooled USS NAUTILUS went to sea in January 1955 and sent the historic message: "Underway on nuclear power." The sodium cooled USS SEAWOLF (SSN 575) followed two years later. It was a real thrill to be on the original sea trials. I wasn't as much concerned about the plant machinery as I was diving in a

submarine with a crew that hadn't been to sea in four years! Incidentally, the crew advised me that the SSN (as in SSN 575) stands for Saturday, Sunday and nights for crew members on a nuclear boat. SEAWOLF was a success and after the initial trials completed a 66 day submerged run covering 14,000 miles. A far cry from a four hour high speed run on a diesel/battery submarine!

Fortunately the potential corrosion problems of the water cooled NAUTILUS plant did not materialize, and all future GE effort was directed to the pressurized water type. The first being for USS TRITON, a twin nuclear reactor, 5900 ton ship as large as a WWII cruiser. TRITON circumnavigated the globe, totally submerged, in May 1960—41,500 miles in 84 days, following the original trek of Ferdinand Magellan. Later, with the advent of the Polaris missiles, the attack submarine hull design was modified to incorporate a 130 foot section for the tubes housing the Polaris missiles, the portion of the boat nicknamed *Sherwood Forest*. These submarines, named after American patriots, had the first successful Polaris firing by USS GEORGE WASHINGTON in July 1960.

The very extensive nuclear powered ship propulsion program has resulted in a current fleet of 72 SSN nuclear attack submarines, 18 SSBN ballistic missile submarines and 8 CVN nuclear powered aircraft carriers. I believe that, regardless of the cost, the program was a huge success. First and foremost was the deterrent effect of Polaris-armed nuclear submarines hiding in the ocean depths, any place around the globe, and capable of retaliation to an enemy attack on the U.S. It provides a deterrent that cannot be minimized. The will of the United States to use such capability, if necessary, I believe, kept the peace in the years of the Cold War. The unlimited range and flexibility of a nuclear carrier force, protected by nuclear attack submarines, also was and is a major deterrent particularly in today's mid-East situation.

A second benefit from the extensive Navy program is the technology boost to the world's civilian nuclear power efforts. With the exception of the former Iron Curtain countries, the technology of the Navy program has provided the stimulus for the development of the pressurized water reactors throughout the world. The U.S. Navy set the example, set the standards, funded most of the relevant technology, and, at least in the U.S., trained many of the operations personnel. These Navy reactor operators,

on leaving the Navy, took key positions with many of our electric utility companies. And they will be available to be called on in future years when the world really gets serious about global warming and moves away from burning fossil fuel for electrical generation. We should talk not only about alternate energies but also about alternative wastes. For example, 1 kg of firewood produces 1 kwhr of electricity; 1 kg of oil produces 4 kwhr of electricity; 1 kg of plutonium produces 6 million kwhr of electricity. The limited volume of nuclear power wastes is one of the greatest advantages of nuclear power.

The success of the Navy nuclear program to a large extent was due to the caliber and dedication of the Navy personnel involved. Be they officer or enlisted, they believed in what they were about and without their commitment, it couldn't have happened. One individual who merits being singled out was Admiral Hyman Rickover. More than any other, he was committed, impatient, an effective leader, a brilliant intuitive engineer, and a master politician. Without his drive the program would have cost more and taken longer. I'm glad he was on our side and I learned more from him than any other person in my career.

I'm afraid that this afternoon I've concentrated too deeply on the nuclear power side of the Navy but it's the part I am familiar with and is a great success story. Some of you are committed to Navy pilot training, and your chosen branch has had their major success and heroes. I've watched too many carrier landings, really controlled crashes, to not have a great admiration for people who do that for a living. And I'm impressed with you computer system graduates applying your Rensselaer education to cryptology—a science that gave the U.S. Navy a huge advantage in the Pacific theater in the 1940s.

Gentlemen, to you who are graduating and being commissioned this afternoon, my heartiest congratulations. Well done! God speed!■

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JEFFERSON'S THOUGHTS ON TORPEDOES AND SUBMARINES
As Written to Robert Fulton

Submitted by
CAPT James H. Patton, Jr., USN(Ret.)

I, as many submariners, have felt blessed to have served in several wardrooms sometimes heard described as "...the greatest collection of minds since Jefferson dined alone." Recently, while reading a collection of his writings, I felt that the following letter to Robert Fulton not only fully warranted that euphemistic description of high intellectual standards, but had a prophetic flavor to it--particularly as the type of people our Submarine Force would need (what would today be considered as *misspellings* are as the book reported that he wrote the words).

Monticello, August 16, 1807

Sir,

Your letter of July 28, came to hand just as I was about leaving Washington, & it has not been sooner in my power to acknolege it. I consider your torpedoes as very valuable means of defence of harbors, & have not doubt that we should adopt them to a considerable degree. Not that I go the whole length (as I believe you do) of considering them as solely to be relied on. Neither a nation nor those entrusted with it's affairs, could be justifiable, however sanguine their expectations, in trusting solely to an engine not yet sufficiently tried, under all the circumstances which may occur, & against which we know not as yet what means of parrying may be devised. If, indeed, the mode of attaching them to the cable of a ship be the only one proposed, modes of prevention cannot be difficult. But I have ever looked to the submarine boat as most to be depended on for attaching them, & tho' I see no mention of it in your letter, or your publications, I am in hopes it is not abandoned as impracticable. I should wish to see a corps of young men trained to this service. It would belong to the engineers if at land, but being nautical, I suppose we must have a corps of naval engineers, to practise & use them. I do not know whether we have authority to put any part of our existing naval establishment in a course of training, but it shall be the subject of a consultation with the Secretary of the Navy. Genl Dearborne has informed you of the urgency of our want of you at N Orleans for the locks there.

I salute you with great respect & esteem. ■

LETTERS

ON SUBMARINE CONNECTIVITY

February 17, 1998

Dear Admiral Holland:

I read with considerable interest the article in the January **SUBMARINE REVIEW** adopted from your very perceptive remarks to a submarine communications conference in June 1997.

Having been on the retired role and away from submarine duty for 25 years, I obviously have no current knowledge of submarine operations and communications. However, as a regular reader of **THE SUBMARINE REVIEW** I have often wondered about the discussions concerning close integration of attack submarines with surface and air task groups.

There have no doubt been manifold advances in communications capabilities from what was available to those of us who participated in the early development and use of nuclear powered submarines. But the characteristics of the ocean and the relevant laws of physics probably have not changed. And it is probably even more true now that, while a submarine is transmitting either electro-magnetic or sound energy, it has forfeited its most important offensive characteristic and its most effective defensive weapon—concealment and stealth.

Accepting that some current war planning scenarios require that attack submarine operations be coordinated with surface and air task groups, I would certainly second a point I think you have made; i.e., such coordination, if it is to be effective, must be achieved without the need for frequent communications transmission by the submarine—by adapting proven past submarine communications and modus operandi to these operations.

In my recollection a submarine operating in close coordination and frequent two-way communication with surface and air elements is really not a submarine, and it is a very poor surface ship. And the lessons of history would caution that undertaking such operations in actual hostilities would incur a high risk of losses due to *friendly fire*.

Respectfully yours,
C.S. (Chuck) Carlisle
2327 Harris Avenue
Richland, WA 99352

FURTHER ON SUBMARINE CONNECTIVITY

March 12, 1998

Dear Captain Carlisle:

You have stated the problem clearly and succinctly. The tradeoffs between stealth and connectivity are difficult. The lessons of the submarine campaigns of World War II have not been lost, up until now, but they are threatened regularly from two aspects. The first is the assignment of submarines to Task Forces where commanders have little or no comprehension of the capabilities and limitations of the submarines assigned to their command and no experience in using them. Since most of these officers are naval aviators from an entirely different C3 regime or culture—one which tends to talk a lot rather than listen a lot—they become uncomfortable with forces *not heard from*. The concept of negative information being real information is difficult to grasp for persons used to radar and link fed intelligence. The result is these officers often want to *hear* from their submarines just to know she is there.

The second threat comes from the expansion of communications and information management technology which allows an ever larger amount of data to be sensed, processed, exchanged and displayed. At every level of command the understanding of time late, uncertainty of location, sensor overlap, performance of the solution algorithms delays in transmission, communication path latency, and related technical issues is weak at best. Few users of modern information technology, including the submariners, understand the nature of the radio options and processes by which they are executed. Nurtured on pro-football, most officers expect live video all the time. Places where large antennas can be mounted can come close to this dream but disadvantaged users are expected to do things which violate the laws of physics.

As people become more experienced in the use of communications and associated information technology, much of this will be sorted out. As evidence I submit that the officer the most to advance Command and Control in the Navy today is a submariner, Admiral Archie Clemins, CINCPACFLT. As the Force builds more and more people who become competent in these matters, many of the difficulties of the present will be solved. My intuition further tells me that most of those solutions will come from the

operating forces and not from our laboratories or vendors.

Admiral Kelso, with whom I had been shipmates in an earlier assignment, once growled at me after an exchange about C3, "Who the hell made you a wizard?" I had to enlighten him that "In the land of the blind, the one eyed man is king". The one common characteristic of all successful submariners is the intellectual fortitude to figure out how things work. When submariners in general direct that focus to communications, much of the problem will be solved.

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

Editor' Note: In May or June the Naval Institute Proceedings will carry Rear Admiral Holland's essay, The Submarine in Network Centric Warfare: A Disconnected Node?

A TWO CREW STRATEGY FOR SSNs

January 2, 1998

I read with great interest the articles by Lieutenant Gittleman and Captain O'Connell regarding a two crew strategy for a 50 SSN Navy. It's an interesting approach. While serving onboard USS PARCHE (SSN 683) during a lengthy overhaul and conversion in the late 1980s, we mused about the idea of having separate *shipyard* crews so that we could go to sea and keep up our readiness.

There are a few issues I'd like to point out in Lieutenant Gittleman's article that need to be further addressed. First, there would be a significant on-going cost in training and support (such as admin personnel and facilities) of the additional crews. Another consideration that his calculations do not take into account is the *time value of money* (such as inflation, etc.) to derive the true present value of each scenario in order to make a more valid comparison. Lastly, while his suggestion for forward deployment of crews to extend core life is a good idea, there are again additional costs here in the form of travel, overseas base support, etc. There would be political issues to be worked out too. And I'd want to check on how an increase in OPTEMPO would affect the overall service life of a SSN—the designers probably did not take into account a two crew schedule when they were originally built.

Having said this, should we consider other alternatives to the impending budgetary constraints? With the passing of the Cold War, future U.S. military concerns are now concentrated on regional conflicts such as possible on the Korean peninsula. In these types of scenarios, our SSN efforts will be primarily ASW and expeditionary warfare support in a littoral environment instead of engagements in an open ocean environment. Thus, the need for SSNs to maintain high speed, submerged runs over long distances has diminished. Since this need was a key driver for employing nuclear propulsion systems onboard U.S. submarines, has the time come to consider bringing back lower cost conventional submarine propulsion systems? In addition to lower construction costs, they would be less expensive to maintain and might require smaller crews. Yet they would still be a highly effective weapons platform in a littoral conflict.

With continuing changes in the world order, we need to be continually rethinking the type of effective weapons (from both a cost and firepower basis) we need in our arsenal to meet these challenges. There is and still will be a need for nuclear submarines in the future. However, the additional realities of budgetary constraints and changes in warfare environments require us to think more *out of the box* and consider other alternatives. A conventional propulsion system is one idea and there are probably many others.

Thank you for the opportunity to comment on these articles. I thoroughly enjoy reading **THE SUBMARINE REVIEW** and keeping more in touch with our submarine community.

Very respectfully,
LCDR Matt Zirkle, USNR

MEMORIAL FOR AN EARLY SUB BASE

February 3, 1998

J.P. Holland's holy ground will be remembered with the help of ET1(SS) Milt Seltzer (Steelhead).

The New Suffolk, New York Holland memorial Project he is undertaking will see a memorial put in place way out there on Peconic Bay, at the corner of First and Main Streets, where around the turn of the century the Irishman tested his boats and, across the way at Sag Harbor, had his Whitehead torpedoes tested at the Bliss

Company.

I took a picture some years ago of the cast iron Holland Memorial Street marker where Seltzer and others will be doing the honors. A worthwhile undertaking.

Martin F. Schaffer

Editor's Note: Martin Schaffer sent along a copy of his photograph of the historical marker. The text of the marker is as follows:

FIRST SUBMARINE BASE

This marks the site of the first submarine base in this country where U.S.S. HOLLAND, first submarine commissioned by U.S. Navy was based for trials. In the period between 1899 and 1905 six other submarines of the Holland Torpedo Boat Co. were based at this site which was known as the Holland Torpedo Boat Station. Naval maneuvers between submarines and the U.S.S. Torpedo Boat Destroyer WINSLOW of Spanish War fame were held in this waters.

ISRAELI TORPEDOES

February 8, 1998

Dr. Milford's most useful analysis U.S. Navy Torpedoes: Part Seven (**THE SUBMARINE REVIEW**, January 1998) states that Israeli motor torpedo boats launched three torpedoes against USS LIBERTY in 1967. In fact, five torpedoes were launched: MTB 203 launched two, MTB 204 launched one, and MTB 206 launched two.

Three of the torpedoes missed astern. One fired by MTB 203 passed ahead of LIBERTY and one struck the hapless intelligence ship.

I understand that of more than 40 torpedoes launched by Israeli forces in various conflicts during the past 50 years, this was the only torpedo known to have struck its target.

Norman Polmar

THE SUB LAUNCHED NUCLEAR CRUISE MISSLE DEBATE

February 21, 1998

May I pass along my comments on the arguments for retention or discard of the TLAM/N capability in SSNs to include:

- BZ to Bill Norris, Lieutenant Kostiuk and Lieutenant Commandeer DiOrio. Their writings are throughly professional in all aspects: content, arguments and format. They brought the entire League membership up to speed on the pros and cons of the TLAM/N as a Navy weapon system (only) for submarines.
- The *con* arguments notwithstanding, I find myself solidly on the side for retaining TLAM/N in SSNs. Pragmatically, the strongest argument for its retention is President Clinton's acceptance of this system for retention only in the Navy and only attack submarines. The tactical and strategic need for it on SSNs already has been argued and accepted by the highest national authorities. It is part of the SSN mission package! This status has much potential for positive budget fallout (excuse the pun) in near term and outyear allocations concerning SSNs. Ye who would jeopardize this exalted position—bite your tongue!
- Again waxing pragmatic, the weakest aspect of Lieutenant Kostiuk's paper is the (persistent) emphasis on using *needy* submarine causes. In my estimation, this thesis tends to brand Lieutenant Kostiuk as being a bit naïve concerning the budget process. If my memory serves me, "it just plain don't work that way". Whatever *other* submarine-related budgetary needs exist, their satisfaction will ultimately depend upon how effectively their sponsor argues their funding requirements. Further, these arguments and the resulting decisions will be made independently of TLAM/N dollars!
- Keep the TLAM/N! Maybe it (and its possible employment) will result in a greater number of SSNs for our Navy.

Sincerely

CAPT Howard Venezia, USN(Ret.)

E-MAIL TO THE BOATS

March 12, 1998

Dear Captain Hay,

I am EMCM(SS) Mike Hurley, USS PROVIDENCE (SSN 719) Chief of the Boat currently deployed with the STENNIS battle-group. **THE SUBMARINE REVIEW** is a great publication and my fellow Chiefs enjoy reading the articles. As you focus on the growth of technologies and the expanded potential of submarine operations, consider that I am sending this to you while underway. We receive and send e-mail through servers at either COMSUB-LANT or COMSUBGRU EIGHT. The 40 word family grams are just a memory. (I think the squadron may still have a few for you that just never made the journey—ask if they can e-mail them to you.)

Too often only Quality of Life issues with a large price tag receive attention. Sailor e-mail is an extremely low cost program for both the Submarine Force and the Sailor. As programming is developed to automatically route traffic to the ship, shore intervention may no longer be required. I can tell you first hand there has been no single morale boost to operational crews than Sailor e-mail. My crew now has the ability to keep in touch with family and friends daily. There are of course limitations; text only files w/o attachments, security considerations for outbound traffic and reviewing incoming traffic for sensitive information.

We are able to pass personnel information to our supporting folks at PSD servicing our pay/personnel records, keep in touch with the squadron staff and, of course, tell our wives to jiggle the red wire to the car battery that we've been meaning to get to.

What's next—attachments, graphics, pictures, video—or when it all crashes, maybe you will get those missing family grams.

Going Deep,
EMCM(SS) Hurley, USN

U-BOAT FAR FROM HOME

by David Stevens
Allen and Unwin Pty Ltd, 9 Atchison St.
St. Leonards, New South Wales, 2065 Australia
223 pages, 36 figures and photos
11 maps, appendices, notes and bibliography
ISBN 1 86448 267 2

Reviewed by Dr. Richard Thompson

In this splendid volume David Stevens, RAN(Ret.) tells the story of the operations of U-862 in the Indian Ocean, Far East, and around Australia in late 1944 and early 1945.

By mid 1944 U-boats in the North Atlantic had become the hunted instead of the hunters, lasting on average only eight weeks, and Admiral Doenitz decided to deploy a number of boats to the Indian Ocean where targets might be less wary and ASW escorts less skilled and plentiful. U-862 was a Type IXD2 U-boat designed to carry the war to distant theaters: she displaced 1804 tons submerged (twice that of the Type (VIIC) and had a capacity of 442 tons of fuel oil, giving her (theoretically) a range of 31,000 miles. Following seven months of acceptance trials and training in the Baltic, U-862 left Kiel in May under the command of Kapitanleutnant Heinrich Timm for Norway, ultimately breaking out into the Atlantic via the Denmark Strait at the end of June. In addition to her crew of 64 she carried 26 torpedoes and hundreds of steel flasks of mercury, vital to the Japanese war effort. Timm and U-862 attacked several vessels in the vicinity of Madagascar before arriving at Penang, Malaysia, in the beginning of September. U-862 made a cruise around Australia, sinking two more ships before returning to Jakarta. U-862 was unable to depart for Germany before the surrender in May, whereupon she was seized by the Japanese and renamed I-502.

U-Boat Far From Home is really an outstanding example of military history, a fascinating story well told. Stevens gives us details of the training, manning, and organization of U-862; the status of anti-submarine warfare around Australia; the difficulties of supplying and directing the U-boat flotilla in the Indian Ocean; and the vital role of codebreaking and direction finding in hunting U-boats in the Indian Ocean. The narrative is fast paced and never tedious. The maps are clear, properly scaled, and abundant;

especially noteworthy were the inclusion of air search radars and direction finding fixes on maps illustrating the track of the U-boats. The photographs are almost all appearing for the first time, and are very germane to the text. The detailed operational summary of U-boats deployed to the Far East (Appendix 2) underscores the futility of Doenitz's stratagem: of the 47 U-boats sent, 15 were sunk before reaching the theater and 13 more were sunk in the Indian Ocean and surrounding waters, having accounted for a total of 65 vessels; only five boats ever returned to the Reich. For those interested in the history of the submarine in World War II, this is an excellent addition to your library; for those particularly interested in the *U-bootswaffe*, it is a must. I (and probably many others,) will be eagerly awaiting Mr. Stevens' next book.

WOLF U-BOAT COMMANDERS IN WORLD WAR II

by Jordan Vause
U.S. Naval Institute Press
Annapolis, MD 1997
ISBN 1-55750-874-7

Reviewed by Richard Boyle

This is a superb book, and Jordan Vause provides extraordinary discernment of the legendary tenacity and resilience of German U-boat commanders during World War II. The array of more than 1400 WWII skippers is a breathtaking statistic by itself. Spirit within the *U-Bootwaffe* has a long tradition. "[I]t survived [World War I] intact, lasted through a bitter peace, survived a second war, and is evident in U-boat veterans today."

Vause determined early on that the "common image" of a U-boat commander was not only out of reach; it did not exist. Most of the book is devoted to an accounting of the motivations and experiences of the following individual commanders: Karl Dönitz, Otto Kretschmer, Wolfgang Lüth, Karl-Friedrich Merten, Victor Oehrn, Jürgen Oesten, Günther Prien, Erich Topp and Herbert Werner. We can recognize the prominent aces; those less familiar were, if anything, more fascinating.

The brief biographical sketch presented for each of the above reveals much about the selection process, early training afloat and submarine indoctrination.

Reactions to captivity involves disturbing perspectives for a few

commanders (some were not repatriated until 1947). Reflection on captivity could result in *barbed wire disease*, characterized as a halt to mental development. Attitudes appeared to be frozen at the moment of capture. For some, readjustment to the reality of defeat took a long time.

Horst Bredow, who served as Second Watch Officer in U-288 in early 1944, has been curator of the U-Boat Archives at Cuxhaven for more than 40 years. He is the key figure in preservation of U-boat history from earliest days (circa 1906), continuing with present day activities of the Federal German Navy. The description of the archive complex is accurate and reflects the extraordinary dedication of its curator.

The reader may be surprised to learn that one of the most controversial figures in the book is Lothar-Günther Buchheim, author of the well known novel (film) Das Boot. Some veterans were unhappy with Buchheim because his portrayal was considered "a fairy tale, all make believe", and they thought the story reflected badly on the *U-Bootwaffe*. Most members of the U-boat community were able to tolerate criticism, but there are some who respond defensively whenever the reputation of the U-Boat Command is threatened.

Admiral Dönitz was unquestionably an able leader, but his image suffers because of the writings of Peter Padfield (Dönitz: The Last Führer) and Erick Topp (The Odyssey of a U-Boat Commander). Vause lays out the chinks in Dönitz's armor with quiet objectivity.

One of the most shocking incidents in the book, the Kusch Affair, represents what can go wrong when loyalty falls apart at any level, either up or down, compounded by service in a dictatorship. Oskar Kusch, when he took command of U-154 in February 1943, threw "the obligatory wardroom portrait of Adolph Hitler into the trash can and announced that henceforth idol worship would not be tolerated on his boat." Kusch gradually became an outspoken critic of National Socialism, and in January 1944, his First Watch Officer, Ulrich Abel, charged him with sedition and cowardice. A court martial found Kusch guilty and he was sentenced to death. Dönitz approved the sentence, did not meet with Kusch, and, despite advice from other U-boat officers, "declined to commute it". This apparent failure of Dönitz's bond with his skippers was considered by some to be tragically out of character.

The Battle of the Atlantic was lost in May 1943. Five hundred

forty-six U-boats were lost between 1 June '43 and 8 May '45. The *command mask* of *U-bootwaffe* skippers had a legendary mystique which defies description. Late in the war, they were courageous and fatalistic as they sailed to almost certain death in support of a lost cause. This book is strongly recommended as a guidon for this mystique. It should serve as such for generations to come.

THE UNSINKABLE FLEET: The Politics of U.S. Navy Expansion in World War II

by Joel R. Davidson
U.S. Naval Institute Press
Annapolis, MD 233 pages
ISBN 1-55750-156-4

Reviewed by Donald Hamadyk

The subtitle of this enlightening book immediately reveals its flavor. Threaded throughout a detailed chronology of the various boards and committees that contributed to WWII naval planning and expansion is a clear emphasis on a few key individuals and their impacts. Although at times somewhat prosaic, the story unveiled by Davidson shows just how strongly personality and politics can play in shaping acquisition policy. There is a primary focus on aircraft carriers, surface combatants, and destroyer escorts, with the submarine element interlaced throughout.

The Unsinkable Fleet describes the progress over time of the following elements: high ambition for fleet expansion, argument of the case for Navy priority, shock to the country's systems as expansion was implemented, the impact of not considering important planning elements, and the aftermath of imperfect execution. The shift in focus from pure volume of warfighting tonnage to seemingly ignored ripple effects and interlinkages among manufacturing resources, ship's manning, and army troop transport requirements, to cite a few, makes the book an eye opener. This is not to mention the varied and often loose approach to basic requirements establishment which is discussed at length in a few instances. Important to note, however, is the ultimate victory by the Navy in building a tremendously effective fleet.

The foreshadowing in the first chapter discusses the method by which ultimate naval, ground unit, and strategic bombing requirements were first derived. The end results were largely uncoordina-

ted plans with no detailed rationale, compared against each other literally in the final hour prior to submittal, and which resulted in the *requirement* for a two ocean fleet able to win a strong offensive in either ocean. This example proves to be a precursor to many similar instances ahead. The attack on Pearl Harbor is then portrayed as an initial pointer to the vulnerability of the requirements development and satisfaction processes, since it introduced a *load to the system*.

Further hints of the overall theme arise when Mr. Davidson outlines the founding of the Joint Chiefs of Staff in two contexts: On the surface, establishment of the JCS gave every appearance of an honest effort at increasing the *jointness* of the services' resource planning. However, the implementation of joint planning under this system fell prey to over-delegation. According to the book, the actual planning work was accomplished by about eight full time planners who were primarily junior officers from the various services, clearly in no position to deviate even slightly from their individual party lines. Thus, the special interests known affectionately in the defense procurement jargon as *ricebowls* were strongly present, spoiling any chance of joint, objective resource balancing. Mr. Davidson reiterates this view repeatedly.

The approaches and philosophies of Admirals King and Nimitz, Congressman Vinson and General Marshall are all discussed in varying detail to support the story. This element is perhaps the most tantalizing and least developed aspect of the otherwise excellent story. It is also quite understandable that this is the most difficult aspect to reconstruct from scholarly research. More indepth biographical elements of these figures in a follow up work could certainly prove fascinating, especially in terms of the motivation for their behavior. The extension of personality from the service leadership to the resulting programs shows how closely linked these elements are. The Navy leadership continually drove forward with claims for expansion needs, and in so doing deftly manipulated the bureaucracy. The Army, on the other hand, repeatedly ended up in a reaction mode, and in several cases simply was forced to back down from their initial requests due to a less strongly argued case. Several instances of Navy decision makers going directly to President Roosevelt after unsuccessfully pleading the case for further fleet expansion give the reader some idea of the powers of persuasion exercised during these trying times.

The Unsinkable Fleet includes several items of specific interest to the submarine community. For example, there is a discussion

of the gradual loss in confidence by planners in Naval Intelligence. As the damages inflicted by threat submarines turned out to be less closely linked to pessimistic projections provided by ASW experts in projected and actual losses is one area where Mr. Davidson presents summary tables which significantly aid the reader in grasping points. Also of interest to submariners, at the end of the war Forrestal saw the Soviets as the premier emergent threat, which set the stage for the Cold War. Part of the outfall of this philosophy was the genesis of a new submarine design, as well as the eventual recognition that Forrestal was a visionary in this respect. As the current submarine community looks ahead to three very new approaches: extensive jointness, network-centric warfare concepts, and a future threat that contains multiple unknowns, we would do well to pay close attention to Mr. Davidson's slice of history. These new concepts will demand rigorous thought in establishing requirements, and well developed planning tools and processes.

Contrasting the fleet expansion portrayed here with the requirements process in place today, clearly the difference between wartime and peacetime, or wartime and cold wartime, plays the biggest role. The urgency of getting vessels to sea appeared to provide self sustaining momentum for further expansion. Another key to the puzzle, and perhaps equal in impact to the strong personalities and urgency of the time, is the lack of standard, effective tools for development of overall requirements. Time after time, this led to each service claiming highest priority for their particular missions. As a shipbuilder with only topical knowledge of the details of the force structure planning process in place today, this reviewer can only assume that the mechanisms, checks and balances, and technological tools used in wargaming and planning today deliver a more definitive requirements *answer* than what has been described in The Unsinkable Fleet. The mandatory interactions among Secretary of Defense, Chairman of the Joint Chiefs of Staff, and the Services, as well as the setting of Defense Planning Guidance, the attention given to the Quadrennial Defense Review, and the rigorous Programming, Planning, Budgeting and Scheduling system would all indicate that we are miles ahead today in rigor of thought. Additional focusing documents such as Joint Vision 2010 provide a framework for continually calibrating requirements.

From a shipbuilder's standpoint, there are several fascinating aspects of the book. The effective establishment and immediate productivity of *emergency* shipbuilding facilities, and the strong

advocacy of Liberty Ships by Admiral Emory S. Land are two examples. The exigency of war is shown to bring out resourcefulness in building ships faster. As one example, the newly established New York Shipbuilding Corporation by 1944 had cut the manhours required to build a light cruiser from 7.7 to 5.5 million after just a short *learning curve*. Similar reductions in other yards are also discussed. Mr. Davidson chooses a late 1942 milestone (the setting of force structure expansion goals by a "Joint planning committee ... primarily on perceived availability of resources, not strategic requirements") as a symbol for the severity of the lack of good estimation tools for force requirements at that time.

Two very related phenomena described well in the book are the decoupling of ship's manning requirements with fleet expansion, and decoupling of available manufacturing and raw material resources with fleet expansion plans. These point up the generally disjointed perspectives among the players in the planning community at that time.

The book is wrapped up nicely with a review of the continued success of Admiral King and his staff in the ongoing fleet expansion argument, the momentum of this expansion which generated a life of its own (helping to provide built-in justification for continuing the expansion) the longer term element introduced which enhanced the overall Navy program, and finally attribution of the above largely to Admiral King's strong role.

In general, Mr. Davidson serves up a very readable book, which has a high level of credibility and a clear, easily followed story line. This is fascinating reading with plenty of detail. As an engineer and shipbuilder, I found myself near the middle of the book wanting for more graphical summarization of the enormous amount of data discussed within the text. This enhancement could bring more life to the book and ultimately better drive home the points being made.

To summarize, this should be an enlightening and enjoyable read for anyone involved in naval warfare planning, naval history, naval shipbuilding, defense acquisition, and the politics of each of the above. Mr. Davidson has clearly done the exhaustive research required to make his points in a credible manner. The reviewer is appreciative of the opportunity to read and comment on this fine book, and the author should be congratulated for a successful, effective first effort.

KANGAROO EXPRESS
The Epic Story of the Submarine GROWLER

by Richard J. Lanigan
Published in 1998
R J L Express Publications
Laurel, FL
ISBN 0-9659995-0-5 $14.95

The following describes an interesting book recently provided by the author concerning significant submarine operations in World War II. These comments which follow include and expand on those contained on the rear cover of the book. Kangaroo Express represents an important contribution to any collection of submarine history.

Kanagroo Express: The Epic Story of the Submarine Growler is a unique collection of recollections of many of the men who valiantly served during World War II on GROWLER (whose nickname became *Kangaroo Express*)—previously unpublished material from the official War Patrol reports of this gallant submarine, and personal recollections from Vice Admiral Arnold Schade, USN(Ret.), then a Lieutenant Commander and Executive Officer of the submarine—the only one of the three captains of GROWLER to survive the war. The written material in the book is well complemented by many pictures, highlighted by photographs of the crew taken both then during the war and in later years.

Who can forget the dying words of the skipper, Commander Howard Gilmore: "Take her down!" and Schade's response to that order which saved the badly damaged submarine and brought GROWLER back to port. Gilmore and two others had been mortally wounded on the bridge by machine gun fire during a close-in attack on a Japanese destroyer. After 10 war patrols including four under the command of Gilmore, four with Schade in command, and two with Commander Ben Oakley, GROWLER was lost with all hands including Oakley while on the 11th patrol.

Schade went on to conduct three more war patrols in the Pacific as Commanding Officer of BUGARA and to a long and distinguished Navy career. His courage and dedication were exemplified in the combat operations in which he participated and in particular in the tremendously difficult period of the fourth patrol when GROWLER's captain was lost and the submarine critically

damaged. Schade continued the same exemplary performance of duty at sea and ashore in such significant assignments as Director, Political Military Division in the Office of the Chief of Naval Operations during the Cuban Missile Crisis, Commander Middle East Force in the Persian Gulf, and Commander Submarine Forces, Atlantic Fleet. In retirement he continued to show his leadership by actively participating in civic affairs.

In addition to his own research, author Richard Lanigan has included vivid accounts of GROWLER's heroic war patrols that have been told by her crew in the *Kangaroo Express* newsletter. These personal narratives are deeply moving, as is the entire book. Many incidents stand out which can only be read to appreciate their telling impact. One of these incidents, probably not well remembered by even those familiar with submarine history, is the successful attack by GROWLER against Japanese destroyers in the Aleutians in early July 1942. Other incidents relate to the continual stress of the individual patrols and the high tension of attacks on the enemy, each attack almost certainly to be followed by the terrible effects of depth charge attacks—effects which could only be understood by those who had been there.

The major incident of all is that in which the Japanese destroyer and GROWLER collide while mutually trying to ram each other, Gilmore orders GROWLER to dive as he is gunned down and dying on the bridge. Executive Officer Schade carries out that order, resurfacing at the earliest opportunity to attempt to continue the attack and look for any survivors, and then takes the boat back to Brisbane through hostile waters—2000 miles on the surface at eight knots for 10 days—with holes in the conning tower and with serious damage internally—and with 18 feet of the bow bent at right angles and war shot torpedoes hanging from the bow tubes with no way to disarm them.

Kangaroo Express is a compelling story of ships sunk and battles won against the Imperial Japanese Empire, patriotic American lives lost and finally the tragic disappearance of GROWLER during her 11th patrol. It is a testimony to the patriotism and daring of the submariners who have served their country. It is also the story of lifelong bonds formed by the men who served their country together and continue to meet annually to perpetuate the memory of those who have died.■

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