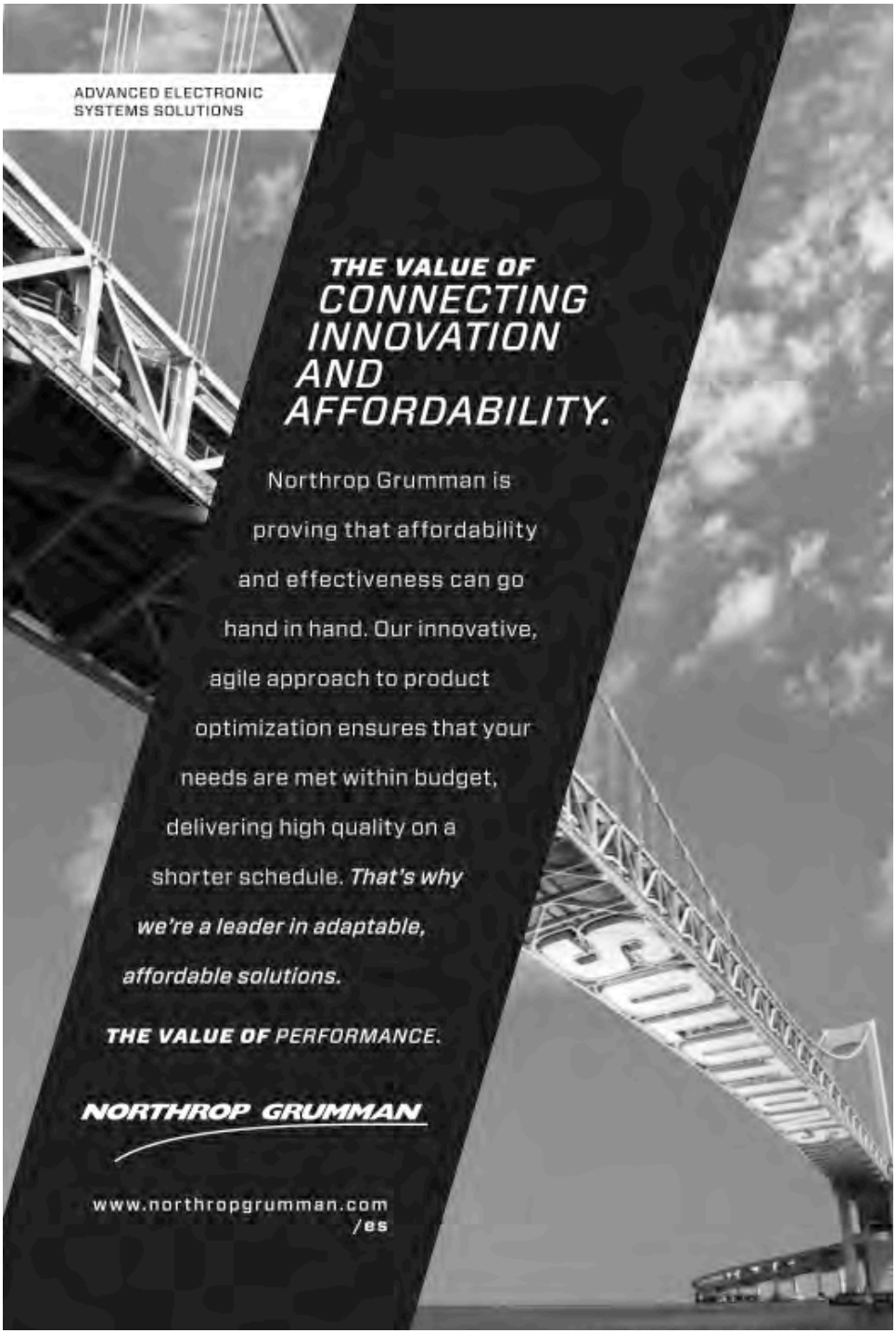
SPRING 2014



EDITOR'S COMMENTS

Two main issues facing the submarine community are the continuation of the ambitious building program to maintain a **credible submarine component** of the national security structure, and the continuing intellectual discourse on the necessity of **credible nuclear deterrence** to the nation's security. THE SUBMARINE REVIEW, in this issue, contributes to both those issues. Admiral Cecil Haney, the Commander of the US Strategic Command, in a recent address presented a very straight-forward description of the Strategic Challenges Facing the US. That presentation is the leading Featured Article in this issue. There are two Force Structure related pieces in this issue, Rear Admiral Rick Breckinridge of the OpNav Staff has put together, and briefed extensively, a graphic picture of Future Undersea Imperatives, mostly in terms of funding. These briefing slides are presented in a stand-alone, self-explanatory manner without accompanying text,

A large section of this issue, amounting to about one quarter of the magazine's substantive content, is devoted to one very important part of the Force Structure issue, specifically the Virginia Class Attack Submarine Procurement program . We have reproduced the entire Congressional Research Service report to Congress on the background and current status of the program. The purpose of these reports is to give the members of Congress the information they need to vote on the authorization and appropriation bills which approve and fund submarine shipbuilding and all other defense acquisition programs. In providing that information to the Congress, Mr. Ron O'Rourke has done a masterful job of putting together a concise picture of the Virginia Class program. The submarine community needs to be as aware of these specifics as are the congressmen and senators as we support the submarine programs we know the country needs. Because those programs, in total, are a very significant part of proposed American expenditures for defense, they are examined carefully every year in light of the current national fiscal picture. A look at Rick Breckinridge's graphics on defense funding and considera-

tion of Ohio Replacement SSBN(X) costs and Virginia costs—with the Virginia Payload Module, will give pause to any rosy feelings of false confidence that the out-years will go as now planned. We, as a community have a lot of work remaining to be done. That's the reason to give the submarine community the full picture as Ron O'Rourke has stated it.

In addition to the main *hardware* concerns of **credible force structure** and **credible nuclear deterrence,** there is the matter of **Professional Excellence,** which has come to define the submarine community, industry and operators. The point here is not to describe what is really the culture and ethos of the submarine community, but to illustrate that one aspect of **Professional Excellence** is to expand that which can be expected from the submarine community. To that end two leaders of our community commented at this year's SubTech Symposium on different aspects for such expansion of expectation. Admiral John Richardson, Director of Nuclear Propulsion, spoke of the need for Innovation, and the actual process of forward thinking in our professional lives.

Vice Admiral Terry Benedict briefed his Strategic Programs Office's analysis of actions and policies necessary for Preventing High Consequence Events. It is obvious that for a community involved in everyday management of both nuclear reactors and nuclear weapons, as well as continuous operation at ocean depth, this is a subject of highest importance. Accordingly, it is recommended that this article be printed out for widest distribution, read at every level and discussed as part of the formal training plan.

Every year the Naval Submarine League awards a prize to a Naval War College student for the best paper on Undersea Warfare, be it about submarines, mines or integrated ASW. This year the winner chose to address the problem of mines in the approaches to China and the need to counter them covertly in the face of shore based air and missiles. This is one of the best papers we have received from our Naval War College Awards program.

For those who don't know the story of the first US submarine lost in the Cold War, Dan Messner's Arctic Sea Disaster tells what

a fire at sea can be like. It's a tale of lives lost to sea state, great heroics in fire fighting and in rescue of the injured. And, because all sea stories of actual disasters have a lesson to be learned it might be a good thing for those now going to sea in our modern marvels to take stock of just what they know about the battery in their submarine and what they would do in case of a battery problem.

Jim Hay
Editor

FROM THE PRESIDENT

Our U.S. Submarine Force demonstrates it's exceptional capability on a daily basis around the world, operating in every maritime theater in support of our nation and our allies. The men and women who build, maintain, and operate these superb ships apply the highest professional standards to their tasks to ensure that the U.S. Navy sustains Undersea Dominance in every combatant theater. This exemplary performance reinforces the Navy's confidence in the Submarine Force's ability to meet its commitments and reassures the Congress that the investment needed to sustain our Submarine Force in the future provides exceptional value to our nation.

With the delivery in August of USS NORTH DAKOTA (SSN784), the first of the Block III VIRGINIA Class Submarines, the submarine builders and the submarine industrial base enhance their reputation of executing the most effective acquisition program within the Department of Defense. The VIRGINIA Class Block III incorporates substantial improvements in capability, with major changes to the bow configuration and sonar suite. These improvements were implemented efficiently and effectively and reflect the professionalism of all on the Navy—Shipbuilder—Submarine Industrial Base team.

While our Strategic Deterrent Force, the most reliable and most survivable leg of the nuclear TRIAD, continues to excel in the performance of its vital mission, the OHIO Replacement Program, the Navy's top priority acquisition program, remains on track to begin construction in 2021. This challenging pace will allow this new class of submarine to begin its first patrol in 2031, as the OHIO class retires after forty-two years of superior service to our nation.

The VIRGINIA Class Submarine Program continues its two ships per year build rate, delivering highly capable submarines ahead of schedule and under cost, benefitting from the "Design for Affordability" initiative begun in 2005. To further enhance the VIRGINIA Class Submarine combat capability, the VIRGINIA

Payload Module initiative will build on the VIRGINIA Program's modular design and construction techniques to provide additional volume on future VIRGINIA Class Submarines to help recapitalize undersea launchers when the four SSGNs operating today retire in the 2020s.

It is critically important that the superb performance of our Submarine Force and the value that our submarines provide to our Navy and our nation are well known and understood by decision makers in Washington, DC. Much has been written about the budget challenges that must be addressed in coming years and hard choices will need to be made. It is essential that, as budget discussions proceed and priorities are established, all parties are well informed and the value of the investment made in sustaining a strong Submarine Force is clearly understood. All of us, as members of the Naval Submarine League, are charged with keeping members of Congress and their staffs aware of the issues that are important to the Submarine Force and the Submarine Industrial Base.

Thanks to the support of our members, the Naval Submarine League remains strong and financially sound. During the Annual Submarine Symposium to be held on 22 and 23 October at the Fairview Park Marriott, a distinguished group of speakers will address many of the challenges that lie ahead. Submarine Force leadership from the acquisition, operational, resource sponsor, and technical communities will address the issues of the day and there will be opportunities for questions. In addition, we will honor the 2014 Fleet Awardees during lunch on Thursday, 23 October, and honor the 2014 Distinguished Submariners and the 2014 Distinguished Civilian during the banquet that evening.

Our effort to improve the quality and the value to our members of the Naval Submarine League website and of our periodic Naval Submarine League Updates is ongoing and feedback from members is appreciated. Additionally, your contributions to THE SUBMARINE REVIEW and the feedback you provide to the Editor, Captain Jim Hay, are appreciated and help us keep THE SUBMARINE REVIEW relevant and interesting.

It is my privilege to serve you as President of the Naval Submarine League and I encourage you to recommend membership to your shipmates and friends.

Finally, as Fall approaches and we go about our busy lives, please keep our nation's men and women in uniform in your thoughts and prayers.

John B. Padgett III
President

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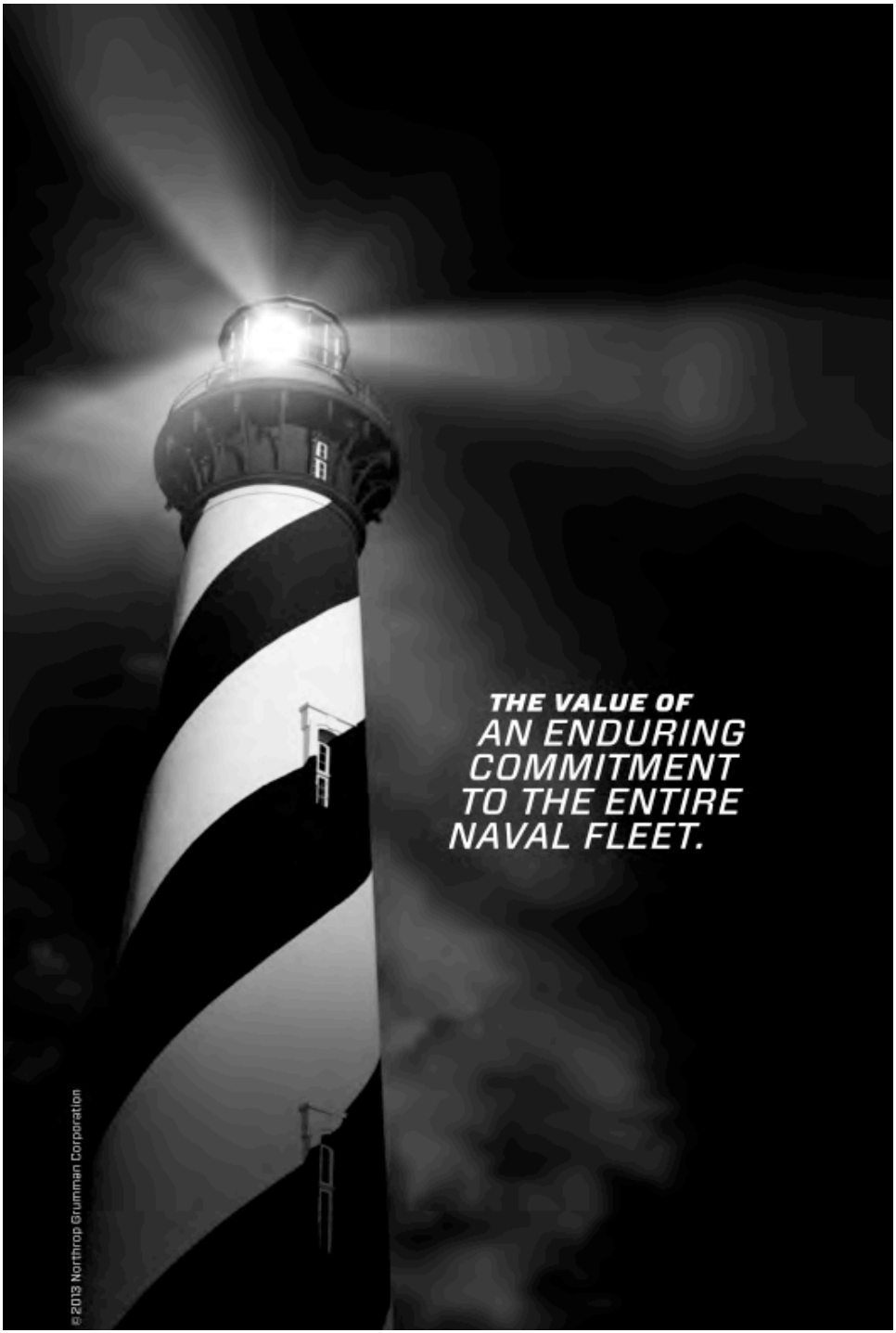
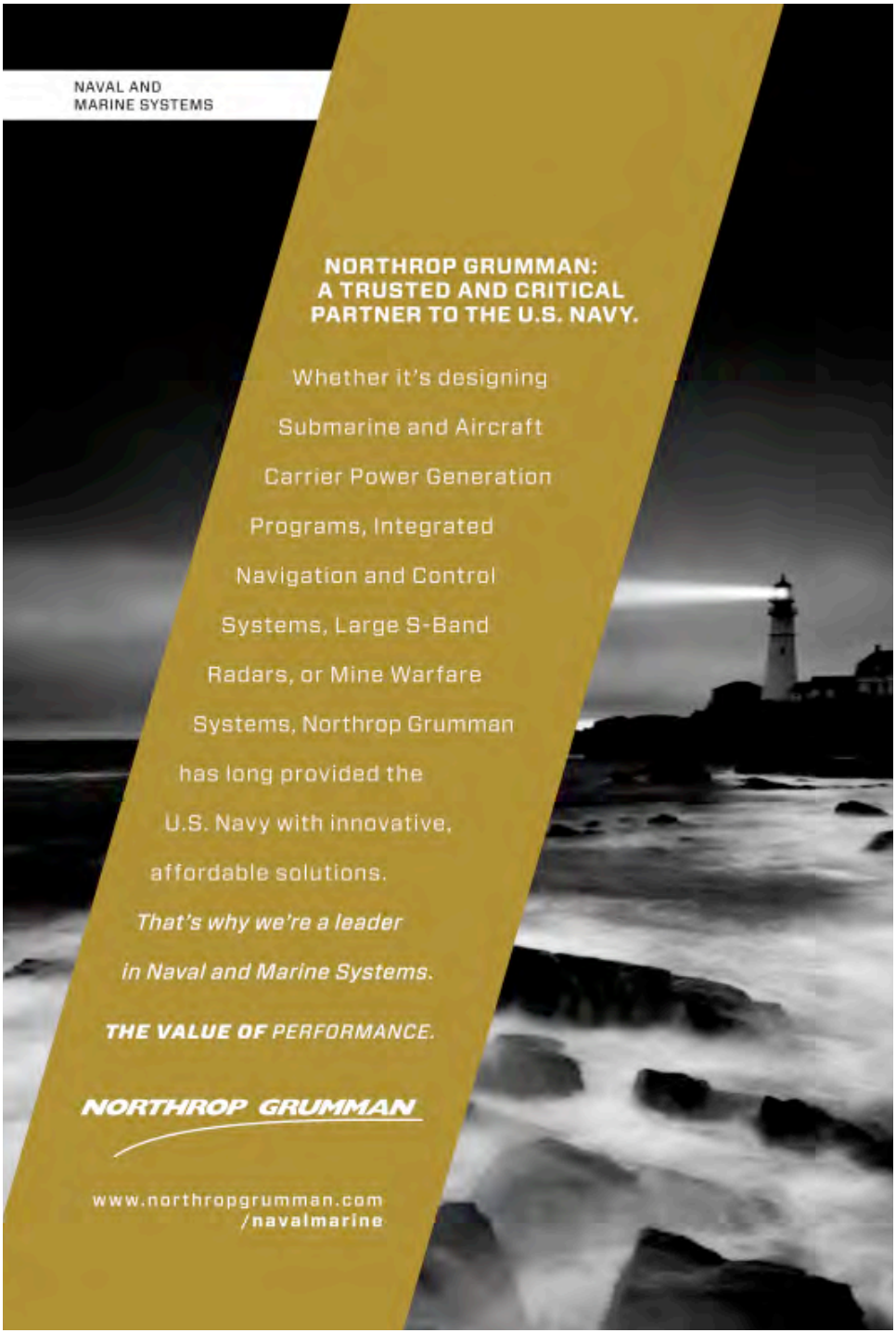
NAVAL SUBMARINE LEAGUE –5025D Backlick Road, VA 22003-6044
PH:(703) 256-0891 Toll Free (877) 280-7827 Fax: (703) 642-5815 E-mail: subleague@navalsubleague.com
Web Page: www.navalsubleague.com

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IN MEMORIAM

ADMIRAL CHARLES R. LARSON, USN, RET.
FORMER NAVAL ACADEMY SUPERINTENDENT

Reprinted with permission from The Baltimore Sun, July 26, 2014, by Mr. Dan Rodricks.

Four-star admiral took command as Annapolis was rocked by scandal in 1990s

Admiral Charles R. Larson, the onetime commander-in-chief of military forces in the Pacific who became superintendent of the U.S. Naval Academy to restore discipline and morale after his alma mater had been rocked by the largest cheating scandal in its history, died early Saturday at his home in Annapolis. He was 77.

Admiral Larson's death was confirmed by his son-in-law, Cmdr. Wesley Huey, a faculty member at the academy. Commander Huey said the four-star admiral had been diagnosed with leukemia two years ago.

"Admiral Larson's death is a great loss for the Navy family and the U.S. Naval Academy," said Vice Admiral Walter E. "Ted" Carter Jr., who took over as the academy's superintendent Wednesday. "He was a great man who served his nation with distinction, honor and dignity."

A native of South Dakota, Admiral Larson went to Annapolis in the 1950s, the first step in a naval career that would eventually span 40 years and most of the globe. After his graduation from the academy, where he was a classmate of John McCain, now a U.S. senator from Arizona, Admiral Larson became both an aircraft-based aviator and a nuclear submariner, twin achievements considered rare for a Navy man.

He served as a junior officer on two ballistic missile submarines and three attack submarines. According to a 2002 article in The Baltimore Sun, two of his seven distinguished service medals were for his command of USS HALIBUT, a submarine that retrieved sensitive equipment from Soviet vessels and tapped into Russian communications cables on the floor of the Pacific Ocean.

Admiral Larson was the first naval officer selected as a White House Fellow, and he served as naval aide to President Richard M. Nixon.

In 1979, at age 43, he became the second-youngest admiral in U.S. history.

Admiral Larson first served as superintendent of the Naval Academy in the mid-1980s. A decade later, after having had one of the largest responsibilities in the military as commander-in-chief of the U.S. Pacific Command, Admiral Larson returned to Annapolis for an unusual second stint as superintendent. At the time, the academy was reeling from scandal. Twenty-four midshipmen had been expelled and 88 had been disciplined for sharing and lying about a stolen copy of an electrical engineering exam.

"My goals are very, very simple," Admiral Larson told a gathering of academy officials, alumni and midshipmen in 1994. "No. 1: to develop character. No. 2: to prove the worth of the service academies to the people of the United States."

By many accounts, Admiral Larson accomplished that mission. He was widely credited with shaping the academy into a more disciplined institution and with establishing a curriculum that focused on character development.

"The most important thing he did for the Naval Academy was to bring it back from a deep malaise," Mr. McCain, Admiral Larson's Annapolis classmate and flight school roommate, told The Sun in 2002.

After retiring from the Navy, Admiral Larson worked in the private sector, serving on boards of companies in the defense, aerospace, energy and construction industries. He also served as vice chairman of the University System of Maryland Board of Regents and chaired a blue-ribbon task force on reforms to university governance and funding.

In 2002, Admiral Larson, who had no political experience, ran unsuccessfully for lieutenant governor, switching his party affiliation from Republican to Democrat to be Kathleen Kennedy Townsend's running mate. Ms. Townsend's selection of the retired

admiral was a secret until just hours before the announcement, and it surprised the Democratic establishment.

Ms. Townsend said Saturday that she chose Admiral Larson because of his reputation for integrity, his experience in the military and because, just a year after the September 2001 terrorist attacks, public concern about homeland security ran high.

"He was a real leader," Ms. Townsend, who served two terms as lieutenant governor, said of Admiral Larson. "He had the qualities of brilliance and honesty—precisely the qualities you yearn for in a leader. He was just what the Naval Academy needed."

Admiral Larson is survived by his wife of 52 years, Sally; and three daughters, Sigrid Larson of Philadelphia, Erica Larson of Annapolis and Kirsten Datko of Arnold.

SUBMARINE TECHNOLOGY SYMPOSIUM

2014 NAVAL SUBMARINE LEAGUE TECH SYMPOSIUM JOHNS HOPKINS APPLIED PHYSICS LABORATORY

ADMIRAL JOHN RICHARDSON, USN DIRECTOR, NAVAL REACTORS

14 MAY 2014

Thank you and welcome. It is a privilege to be here tonight and it is good to see all of the distinguished guests from industry, academia, the Submarine Force, and our Sub League members. Most importantly, thanks to Johns Hopkins University Applied Physics Laboratory and the Naval Submarine League for their unswerving support of this great event and the Submarine Force.

It is right that we pause, come together, review and lash up on each other's notes and leave with one voice.

In a dynamic time, Johns Hopkins University and The Naval Submarine League are a consistent and vocal advocate.

It took a lot of hard to work to make this happen. Tim Oliver at the Naval Submarine League, in the spirit of innovation, worked to get the registration fee reduced this year ($600 vice $650).

LCDR Bob Good and the whole Sublant team, for the months of coordination to get CNO and SECNAV approval for the event.

At Johns Hopkins University Applied Physics Laboratory, Brad Mitchell, for fitting in all the exhibits.

Most of all I want to recognize Admiral Emery, who has run the Sub Tech Symposium since 2004, and is ready to pass on the torch. Admiral, thank you for your leadership in making this truly a world class event. A tremendous effort to make a tremendous event. Thank you.

This year, a timely theme, "Technological Innovation to Influence Offensive Operations". For my part I'll focus on one word, innovation.

We have a proud history of innovation, both on this campus and in the Navy. I'll offer some examples from the past, a few illuminating stories about innovation and winning wars on the backs of emerging technologies. In fact, some technologies that did not even exist before the first shots were fired.

I'll also mention some examples from industry, and tie it all together with a discussion on the family values or principles that bind us all together as innovators.

I recently spoke to another young team, the trident scholars, who are a select group of engineers in their third and fourth year at the United States Naval Academy.

Midshipmen who are amazingly smart, talented, dedicated, and energetic, and who have grit and perseverance beyond their years. They are ready to learn and already advancing the technology so important to our navy.

I should tell you, I was a Trident Scholar in 1982.

But the current generation of Trident Scholars is on the cutting edge. Lasers, unmanned vehicles in the air, on and under the ocean; exploring the electromagnetic spectrum; rail guns; and advanced fuel and propulsion systems.

A quick example. Midshipman Chris House (class of 2014), and a future submarine officer I might add. His research involved Sonic Actuation of Small-Scale Robots in a Fluid Environment. Essentially, these are Micro-robots that could be used for medicine and micro-assembly, powered by acoustic fields. The advantage is safe power delivery within the human body.

And if you look in your water glass, I actually embedded some of these microscopic prototypes in everyone's ice cubes. I'm not kidding. And if you start to doze off or chit-chat too much during my remarks, the acoustics in this room will actually start up the micro-robot. And I won't tell you where they are programmed to go, but suffice it to say it should be enough to wake you up, and maybe even get a standing ovation out of this group.

There is a lot of excitement about innovation around our Navy.

Research is important to advancing our Navy. This spirit of innovation is not a new thing. It has been in our DNA from the

beginning. The CNO and Admiral Klunder at the Office of Naval Research are great advocates.

At naval reactors, we know Admiral Rickover was born with a principle-based, production mentality and that these skills became highly valued and refined while he was the head of the Bureau of Ships Electrical Department during WWII.

He and another NR legend Jack Grigg participated in the salvage and recovery of the electric drive battleship USS CALIFORNIA, which was sunk at Pearl Harbor. This is where these two men deeply ingrained the DNA for how to get things done, right and quickly.

It was a principle-based approach, putting the nation's interests first, shared by men like Admiral Rickover, Vannevar Bush, General Groves, and Admiral Samuel Robinson.

There was a great entry on the Navy Live blog, about a month ago, by the Naval History and Heritage command titled *Game Changing Navy Technology*. I encourage you all to check it out. (April 9th, 2014).

It mentioned radar. Before radar, Navy ships could only track other ships and aircraft with their eyes and their ears. It wasn't until 1922, when the Naval Research Laboratory pioneered the first detection of a moving ship by radio waves and, along the way discovered the principles of radar. In 1935, $100,000 was allocated to naval research lab to begin the development of radar. The blog goes on to say that by the time our country was entering WWII, 20 radar units were in operation and contributed to the victories of the U.S. Navy in the battles of the Coral Sea, Midway, and Guadalcanal.

From interwar to WWII to Cold War period, innovation came in the form of radar, atomic weapons and power, sonar, coding and code breaking, and computers. Sometimes it was developing new technology, sometimes just thinking differently about new ways to use current technology.

It depends on looking at things in a new way. Consider the prosthetic foot. The old *spec* was that it should look like a human foot or a leg. The new *spec* is that it must *work* like a foot or leg and it has. These advanced new prosthetics can be seen on

Olympians, wounded warriors, and Boston marathon bombing survivors, to name a few.

Other examples of innovation in the interwar period include developing the rainbow plans at the Naval War College, devising Blitzkrieg from German general staff, individual radars versus a coastal defense network for the Brits, and submarining—we got it wrong at first, and it took three years to get it right, but then it was one of the most effective weapons in the war.

One area near and dear to my heart is weapons fuzing; it was one element of our collective failure in developing torpedoes before WWII.

You've heard me speak about torpedo fuzing before and the story of the MK41 torpedo. Enough said. Let's discuss another case: proximity fuzes. A great example of an innovation success.

And it happened right here at Johns Hopkins University. It is a great example of an alliance among military, academia, and industry that brought about the proximity fuze.

I recently read a great case study by Robert Lynch about Merle Tuve, the brilliant scientist and motivator. Tuve built a diverse team at Johns Hopkins University Applied Physics Laboratory comprised of scientists and engineers, military and ordnance experts, even amateur radio operators. Quite the *alliance of many*.

By 1942 the team had grown to about 200 people and their sole mission was to contribute and *act on* ideas.

They had a fluid organizational chart where individual status was irrelevant, everyone pitched in *and* no one was exempt. Vital to his team was a belief that this problem could be solved.

Tuve said, "one of the greatest new developments of the war…was the rediscovery of an old principle… that in directing a group of people all you need to do is: Tell the group what the needs are, make the goals conspicuously clear, and invite them as individuals to contribute in the best way they can."

Let's compare performance before and after. The proximity fuze: Once deployed the proximity fuze coupled with radar gun directors was astoundingly successful. It was first used in the Battle of the Bulge in December 1944. Then between December

1944 and April 1945 (4-5 months) the fuze was credited with shooting down 1000 German aircraft.

In the second battle of Britain (summer 1944) and later in the defense of Antwerp (December 1944) the fuze enabled 90% success rates: it took 40 rounds per hit. That compared to almost 20,000 rounds needed just four years earlier.

What did Tuve's team learn? What can we take away?

- That saving time is more often more important than saving money. And first to market is more important than perfection. 80% effectiveness now is more valuable in wartime than 100% later.

- Parallel discovery and development are essential for rapid innovation. We must design and build. "This is a war program – not a scientific program."

- The trouble is always at the top. Take responsibility and don't blame subordinates.

- A good short paper in your hand at the right time and place is a marvelous hatchet for cutting through red tape.

- The cardinal rule: Ownership, responsibility, accountability and authority must have the same boundaries.

- Our moral responsibility goes all the way to the final battle use of this unit. If there is failure there, it is our failure.

WWII may be the only war in history where the outcome was largely decided by technologies that did not exist when the war broke out. The atomic bomb, radar, sonar, the proximity fuze, computers, code breaking. We simply innovated more and faster than the enemy.

And an innovative environment does matter! Let's compare the typical R&D job today against the proximity fuze project of Tuve.

For the typical government R&D project, you have a specific job with a written job description, specific roles for the team members, most aspects of the job are pre-planned, and everyone has specific performance expectations.

Compared to Tuve's group where everyone was expected to contribute and act on ideas, there was a two-way flow of information, contributors were considered people not workers and no one had fixed job assignments, if trouble was encountered, the team's responsibility was to identify alternatives.

As another comparative example, the U.S. and German systems during WWII were quite different.

The U.S. system was team-based and shared ideas. We had a competent staff and people were loyal to democratic principles. The best scientists were put to use in labs and there was an overall sense of urgency to the cause. Everyone shared a vision to see technology transformed into inventions, then to have those inventions produced and deployed in the war.

Compare that to the German system where there was very low sharing amongst individuals. Their government was autocratic and led by people loyal to the cause rather than the brightest and best decision makers. Their top scientists were sent to the field not the labs. Combine all of this with a low expectation that the technology they created would make it to service in time for the war.

Despite our differences, WWII and even the Cold War were closer than we would like. The Fleet boats came on line just in time, despite the depression. Shortly after Germany surrendered, a U-boat full of uranium bound for Japan surrendered to the U.S., showing that Japan also had plans for nuclear weapons. The Japanese were also introducing proximity fuzes of their own. Luckily, the surrender occurred as they were perfecting this technology. As a lesson going forward, we must guard against innovative surprise and mirror imaging.

It is clearly evident that research has always been important to our Navy. And our Navy has been important to the direction of research, a great symbiotic relationship.

My point is that we need innovation, even under financial stress and outside the military. We can look to industry for some other good examples of teamwork, hard work, and brilliant minds, to create value both for the shareholder and for the common good.

Let's look at Hewlett Packard. Their culture of innovation led to unparalleled success for decades. But they had tough times too. The company product line morphed at least six times through the years.

And Apple collapsed in the late 1970's and grew stagnant and faced rocky sales and low market share through the 1990s. But they are now flourishing with I-tunes, I-pad, and more.

What does this mean for our Navy?

It reminds us that innovation is really a new way of seeing old things. To do this, you need a structure to innovate like Tuve's. There has been a lot written about it including works by Tang and Ideo. Innovators know how to minimize the cost of failures and get back to the drawing board.

The bottom line is that you can succeed in times of financial hardship through creativity and innovation. This SubTech team of military, academia, and industry has done it before, we are doing it now, and we will do it in the future.

It is a world-class team and like so many teams in the Navy, it more resembles a family than anything else. Like HP and Apple we have adapted with time. Look around, generations of people here, welcoming the new arrivals to the family.

If this is your first or second SubTech symposium, raise your hand. And if you were at the first or second SubTech symposium, raise your hand.

The *principles* that fueled Tuve are familiar to us through the generations; they ring familiar.

- Our standards are very high
- We work hard

- We don't make excuses; anything worthwhile only comes with hard work

And it must be so. We operate powerful and complex technology. We operate in hostile environments, far forward, at sea, in the air, perhaps submerged, at high speed, unsupported. The nation counts on us to deliver when called, safely and reliably.

- We are highly selective, recruiting the very best people in the country. People want to be part of our team and grow to be a leader. They have moral courage and want to grow stronger.

- We strive for excellence. We celebrate finding problems when they are small and swarm to fix them so they don't happen again. We use initiative to look for ways to improve.

- We are always teaching and learning. Our people become technical experts and members of high-performing teams. Individuals and teams teach and learn from one another, it's a constant in our business.

- We own our work. We are responsible, have proper authority, we are accountable, and we push ownership to the lowest capable level.

- We work in teams, and build our next generation. We respect every member as a potential future leader. We take every opportunity to pass on experience, because there is not a moment to lose. And we teach people our core values by our example.

- Above all else, we are honest, we are addicted to integrity. Our program is powered by truth. Face the facts, no matter how grim.

These principles, these family values, are what enable us to do great things, to advance our selves, and along the way advance our Navy and our Nation. They bind us together, they make us great.

The pressure is on innovation. It has never been more important than now to understand the important role of innovation, R&D, and technical work in the face of budget stressors.

Research and development is always the first thing we cut in rough times; we must avoid this tendency. And not just cuts in funds, I'm also concerned about cuts in attention, cuts in our dedication to innovate. The bottom line is we cannot zero R&D budget and mortgage the future.

Further, our R&D and testing community is under cost and schedule pressure. There are pressures to reduce the number and rigor of tests. We rely more and more on powerful computers and their powerful modeling and simulation, instead of actual testing. This can be a sound approach, as long as we validate the code with data from prototypic tests.

Our sense of optimism and our history of success can also work against us here, giving us a false sense of certainty going forward.

To do what is technically correct we must be judicious, but not cheap; efficient, but not sparse; challenging, but not unrealistic.

The timing matters; now is the time for the Ohio replacement. now is the time to continue to challenge and improve on Virginia class successes.

The Navy, the Defense Department, and the Nation, look to us to uphold the standard. The stakes are more than just financial; the lives of our Sailors and survival of our nation are in the balance.

In a January 1970 memo to young engineers, Admiral Rickover said, "our engineers fail to realize that our designs in the past have worked primarily because there were large margins or safety factors to offset our ignorance and because we had some good luck."

As we go forward, let's be the ones to try to balance the discussion. We in this room need to ensure our leadership in the government, academia, and private sectors, we must maintain visibility into the decisions that are trading away performance and

margin; we must understand the specific nature of the risk we incur; and we must communicate that risk to one another; most importantly to the person who owns and is accountable for that risk.

Let's not forget that we are warfighters, and to be successful we are charged not only with taking risks but with seizing opportunity.

What we do involves an element of risk. To do our part, we must seek to drive the engineering risk to near zero so that when ordered, we will answer ahead flank, push the system to its limits, sprint to the nearest crisis, dive to the deepest depths and will have no doubt that we're ready and will be there.

As we gather in the conference and education center, there is another voice from which we can draw inspiration: Kossiakoff said, "today the Applied Physics Laboratory spirit still burns strongly. The drive to solve problems of national importance continues to guide our priorities. The spirit of adventure has carried us beneath the seas, to the borders of the solar system, and into the human heart and brain."

Those are the words of legendary scientist and Applied Physics Laboratory director Alexander Kossiakoff. Words he shared in 1982, the year I graduated from the United States Naval Academy, and they are words that still resonate today. The Applied Physics Laboratory and SubTech spirits burn strongly.

It has been a tremendous honor to be here tonight. Thank you Johns Hopkins University Applied Physics Laboratory and The Naval Submarine League. This simply cannot happen without you. Thank you.

SUBMARINE TECHNOLOGY SYMPOSIUM

PREVENTING HIGH CONSEQUENCE EVENTS

VADM TERRY BENEDICT, USN
DIRECTOR, NAVY STRATEGIC SYSTEMS PROGRAMS

May 12, 2014

So far at this symposium we've heard about some exceptional technical developments that are underway. Now, I'm going to talk about a less-discussed, but critical, component of technology development and operations – the human component. Specifically, I'll share with you the results of a study we undertook at SSP, and how the findings apply to you and your organizations.

A Challenge of Complex Technology

First, some context. As the Director of SSP, it is my responsibility to maintain the safety, security, and effectiveness of the Trident II Strategic Weapon System (SWS). As you know, the D5 SWS is a highly complex weapon system. We characterize it as a public risk technology because though the likelihood of a disaster with the SWS is small, the consequences are enormous, and they could well affect the public domain. Clearly we must do all we can to prevent such an event.

SSP has been successful at providing the benefits of this technology in a safe and secure manner. However, history is replete with examples of organizations that thought themselves successful yet still suffered catastrophic failures. Think NASA before Challenger or the Deepwater Horizon, which had been recognized with an industry safety award just before its spectacular failure.

I find we do well at SSP with the familiar. New endeavors are more challenging, and we sometimes find ourselves wondering, "How could they do that?"

The nuclear disaster at Fukushima was a wake-up call for us, delivered in the form of the Executive Summary of a special commission established to investigate the causes of the disaster.

The message applies broadly; our submarine community, all of us, can never permit ourselves to fall into the traps that drove the outcomes at Fukushima.

Fukushima

In Japan, before Fukushima, the national narrative was that nuclear power was 100% safe. Clearly earthquakes and tsunamis are out of human control. The reactor disaster on the other hand, was an entirely different story.

The event was part of the series of stimuli that have driven change in Japan. At the same time, the public sense of betrayal by the government and the nuclear power industry led to a complete shutdown at odds with the energy demands of a dynamic recovery. We all know that Japan's desperation for energy resources was a principal contributor to its decision to attack Pearl Harbor in 1941;

little had changed to solve that problem other than the advent of nuclear power.

Following the disaster, the Japanese Diet, their legislative body, launched an unprecedented investigation to find the root causes of the failure. The report is replete with technical explanation, but the Chairman, in his one page summary took another step in root cause analysis. He pointed the finger inward, at the culture of the responsible organizations and of Japan itself.

> "The fundamental causes are to be found in the ingrained conventions of Japanese culture: our reflexive obedience; our reluctance to question authority; our devotion to 'sticking with the program'; our groupism; and our insularity"
>
> *Kiyoshi Kurokawa, Chairman*

When I read those words, I was taken with the succinct relation of culture to catastrophe, and, more troubling, I recognized some of the Chairman's issues as potential problems in my organization. It was this incident that led to our study at SSP. We wanted to know what human weaknesses have spooled together in ways that have led to high consequence events, so that we might help our people develop the strengths that should act to prevent such outcomes.

Strategic Weapons System Elements

As I said before, the SWS is a complex, public risk technology that also delivers a uniquely important national security capability. We must maintain the trust of the public so we can continue to benefit from this technology.

But our system is more than the hardware and software represented by the eight sub-systems of the SWS. The people who engage the system every day are just as much a part of the system operation, and I believe that Fukushima tells us that the strong technical elements of a system can be rendered useless if the human elements of that system are not equally strong.

The reactor disaster at Fukushima was not delivered by the operators who engaged the system after the disruption of the tsunami. They were set up by the woeful shortfalls in design and sustainment of the plants through their lifecycle. The technology developers failed them, leading directly to the operational outcomes witnessed by the world.

So it is for all of us. The outcomes that we attain in our systems are directly a function of the way we engage our systems across their lifecycle. Safety and security of the SWS, my top priority, are clearly one of the outcomes driven by how we engage.

Most, if not all of you, work on systems with similar complexities and histories of success. And while the technical capabilities of your efforts are key, the human element is equally important to your successes.

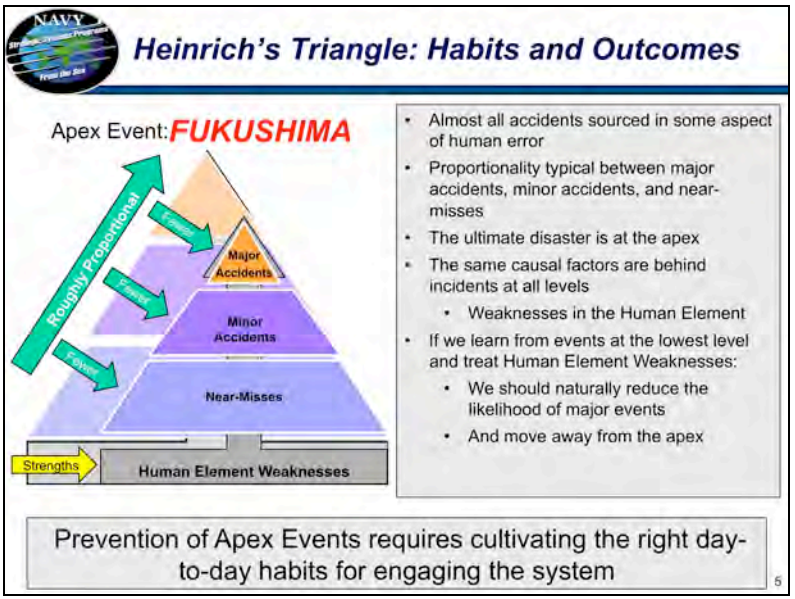


Figure 1

Heinrich's Triangle

So what do we do? A safety engineer named Heinrich wrote about causality of industrial accidents in the early 20th century. His views and findings bear on our challenge. (*See Figure 1*)

Heinrich described a triangle relating data he analyzed from industry. At its pinnacle were major accidents (a fatality), beneath those minor accidents (an injury) and then near-miss events in which no injury occurred. We can add another type above major accidents, and that would be Apex Events like Fukushima – incidents so massive that they eclipse what any organization would call a major accident.

Heinrich found, from the data that he had available, that the types of events occurred in a rough proportion (1:29:300) that seemed to hold up over time. He acknowledged that the ratio was likely to be industry dependent, but expected that similar proportionality would be found. He also found that most of the events were caused by human error, and that the sorts of errors which occurred were common across the categories of events.

He suggested that organizations could reduce the frequency (or likelihood) of events by paying close attention to the human errors leading to near misses, taking action to learn from those errors and strengthen the work force.

Success in strengthening the human element would have the natural result of suppressing all types of events and acting to move an organization away from an APEX event.

It is this idea that we wanted to understand at SSP: what does it mean to have a strong human element, whose culture and habits of operation act to move us away from the Apex?

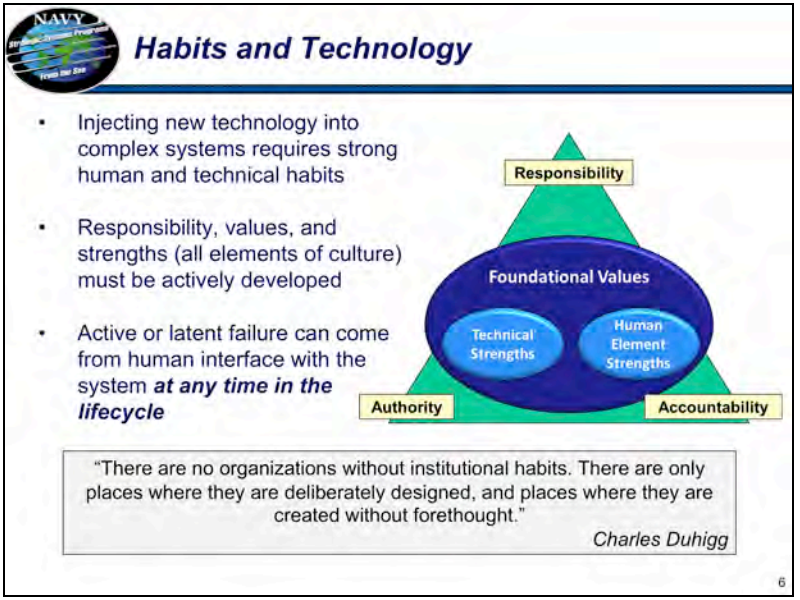


Figure 2

Habits and Technology (*See Figure 2*)

This is where the rubber meets the road in organizational culture. It starts with the TRIAD of responsibility, authority and accountability, which when clearly communicated to our people, empowers them to do the jobs that we want from them.

Foundational values like Respect and Commitment are key to proper organizational function. As stewards of complex or innovative systems, we must have both strong technical skills married with strong human habits (human element strengths). We have to deploy our technical and human element strengths habitually to succeed in our complex system operations. These two concepts are the front-end of an organization's culture, the parts that we actively use day-to-day. I describe all this because every organization has a culture. The difference is whether or not that culture is deliberately designed, or allowed to form without any control.

The latter is where problems come about. An organization without an actively developed culture can atrophy, both in technical and human elements, which can lead to a high consequence or apex event.

And that's how this relates to everyone in this room. The habits with which you engage your systems and technology development can echo for years.

Figure 3

High Consequence Events (*See Figure 3*)

Typically when we talk about high consequence events, there is significant discourse regarding different actions that operators could have taken to prevent a disaster. But many events have their roots in actions or decisions taken years or decades before the event.

Here are the 12 events we examined to understand what human weaknesses lead to high consequence events. These are

incidents like Fukushima, the explosion of Deepwater Horizon in the Gulf of Mexico, and the crash of a B-2 bomber in Guam. (NOTE: there are two NASA events, and two AF nuclear enterprise events)

While there were weaknesses displayed by operators in many of these events, the design and operational decisions by developers, technical authorities, and operational managers were central in most of them.

As designers and developers, you are part of that headquarters and management influence. It is critical you understand how your actions can potentially affect not just the operators of your systems, but also the public at large.

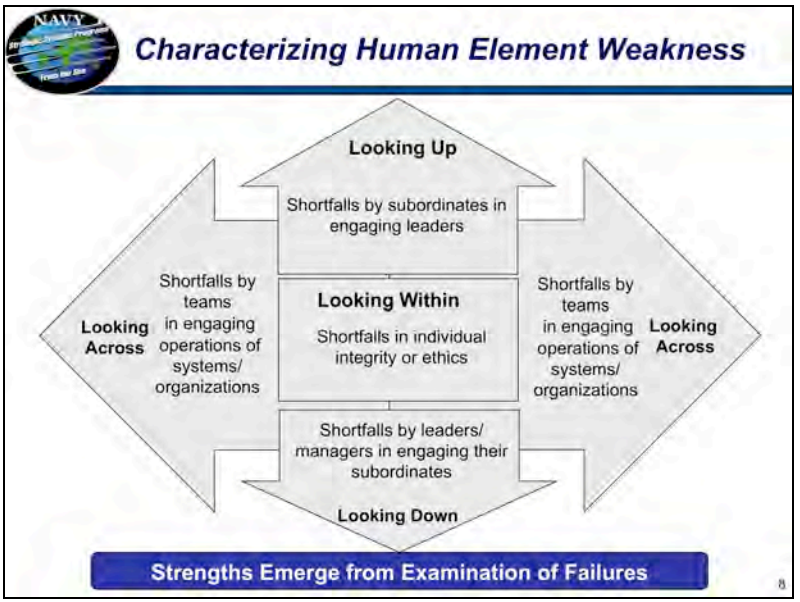


Figure 4

Characterizing Human Element Weaknesses (*See Figure 4*)

When we studied the 12 events on the preceding graphic, we found 22 human weaknesses that operators, engineers, and management displayed that led to the various outcomes.

No single event suffered from all of the weaknesses, but each event was founded in multiple weaknesses. We categorized the weaknesses as follows:

- The Looking Up Weaknesses are habits which result in failures of subordinates to engage their leadership in ways that would help the organization succeed.
- Looking Down Weaknesses relate habits of leaders as they engage subordinates that set a tone of operation which is counter to organizational success.
- Looking Across weaknesses are habits of team engagement which are not supportive of system or organizational effectiveness
- And finally, Looking Within Weaknesses are failures of personal ethics or integrity that can feed system failure.

By learning what weaknesses fed high consequence events, we can understand the corresponding strengths for engaging our system responsibilities that give us the best opportunity for system success, be it safely drilling for oil or reliably providing the sea-based strategic deterrent.

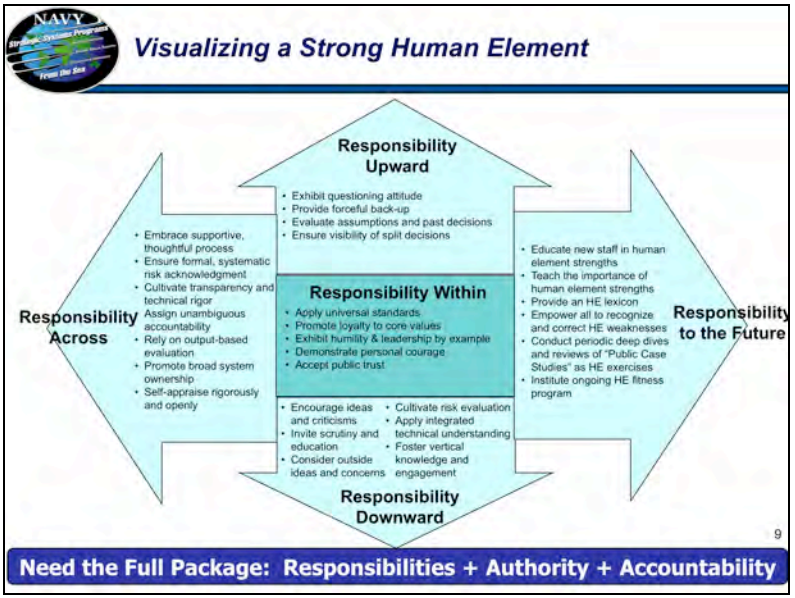


Figure 5

We are using these ideas today at SSP to help us build on our record of success. History tells us that we cannot count on past success to be a promise for future results. (*See Figure 5*)

Here is the full listing of what we characterized as human element strengths. We've labeled these strengths in such a way that their definitions are usually self-evident.

You'll see here the Looking Up and Looking Down weaknesses, those that relate to how supervisors and subordinates interact with each other and the broader system.

And the remaining two categories, Looking Across that relate to team interactions, and Looking Within strengths that concern personal integrity.

We use the weaknesses to help us identify the true root causes of problems, and thereby administer the best corrective action based on the corresponding strength.

You'll also see a new arrow, corresponding to how to turn these concepts into action. Implementation depends upon personnel empowerment and leadership to make these ideas something people use every day.

Figure 6

Relevant Weaknesses for Developers (*See Figure 6*)

Now I'm going to touch on three weaknesses from the 22 we found that are especially applicable to each of you. What's more, I'm going to describe them in the context of how they contributed to one of the 12 failures we studied.

The first weakness is that of a Culture of Production. Many of you may consider production the ultimate goal of your organization, and rightly so. As a developer, you want to produce something on the other end.

- However, this becomes a problem when production is more important than risk evaluation as happened during the Deepwater Horizon incident. There, management placed a priority on capping the well quickly and efficiently so the rig could be moved to the next job. Their emphasis was not on safety and effectiveness and resulted in poor risk decisions regarding completion quality.
- The aggregate result of a series of such decisions was failure of the well capping job, resulting in an explosion that destroyed the rig, killed 11 crew aboard, and caused the worst maritime oil spill in history.
- This weakness of a Culture of Production must be countered by the strength of a Culture of Risk Evaluation. This can be characterized as a keystone habit. A Culture of Risk Evaluation allows an organization to identify where their weaknesses are and take action to fix them.

The second weakness is Sticking to Past Program Decisions. This occurs when an organization allows previous assumptions or decisions to control how it does business.

- For instance, when the Fukushima power plants were built in 1967, theories of plate tectonics were virtually unknown. The safety case was predicated on the extant understanding of seismic vulnerability, later understood to be demonstrably wrong
- As years progressed and the risks of earthquakes and tsunamis became better understood, an engineering assessment revealed that the design basis of the plants' safety systems was inadequate for the tsunami potential. We now know that the risk of such an enormous tsunami, certain to disable the installed emergency power supplies, was about 1 in 20 over the anticipated life of the Fukushima plants.
- The utility and regulator knew these risks, and yet neither took strong action to change the plant's design or alert the public to the increased risk.

- To counter this weakness, organizations must consider carefully when there is a need to review past assumptions and decisions. Such reviews should happen when you realize you're importing previous assumptions into a new system design, when new relevant information is learned, or when using existing systems in a new way. And certainly decision review must happen when a near-miss or accident occurs that shows your assumptions may not be valid any longer.
- As designers, the requirements and assumptions from which you begin must be examined with intense scrutiny. In the case of Fukushima, the decisions of the late 1960s were not challenged for over 40 years, and the consequences were devastating.

The last weakness I'll talk about today is what we call Not My Problem. This is where an individual or a team defines their responsibility as a narrow portion of the overall system, ignoring problems with other areas at the detriment of system success.

- This weakness was evident in the crash of a B-2 Spirit in Guam. Normally hangered in environmentally controlled facilities, the B-2 began conducting deployments to tropical Guam in 2006.
- Early in the deployment an aircraft failed a pre-flight check. The maintenance crew consulted with a support contractor to develop a technically sound work-around to this failure. But the crew did not inform supervisors and did not push this knowledge to the rest of the B-2 maintenance fleet.
- In 2008, a new maintenance crew ran into the same problem. They did not know about the work-around and followed the pre-flight check procedure as written.
- The result was that, when the B-2 took off, its pilots and on-board computer saw the wrong air speed. The aircraft stalled just after take-off, and while the air crew successfully ejected, the B-2 crashed. Luckily, the crash did not

kill anyone, however the $1.4 billion aircraft was destroyed.

- What the original maintenance crews needed to display was a habit of Broad System Ownership. Had they considered the ramifications of the technical problem across the entire fleet of B-2s, the manufacturers could have made the work-around into a permanent procedure.

As developers, it is essential you consider yourselves not only responsible for the areas you control, but also for the entire success of the system.

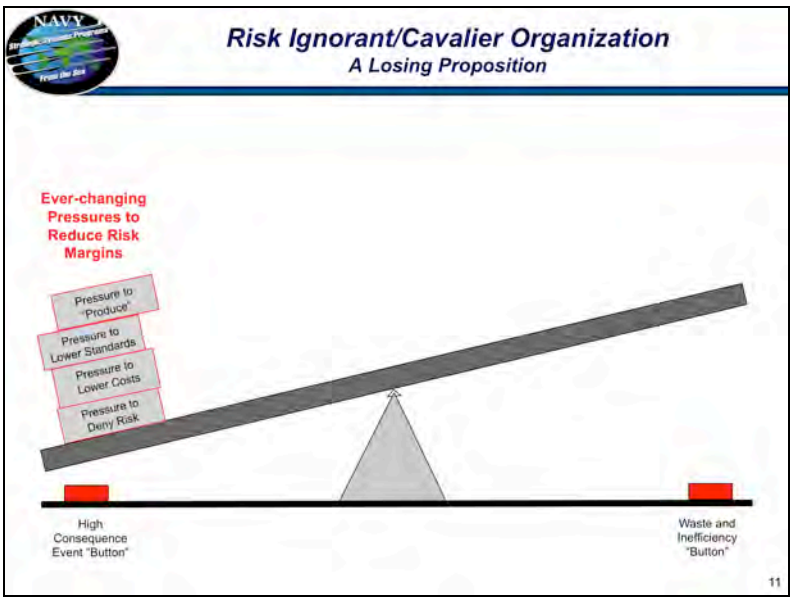


Figure 7

Risk Ignorant/Cavalier Organizations (*See Figure 7*)

The purpose of understanding these habits is so we can strengthen our human element and ensure we continue reaping the benefit of technologies like the strategic weapon system, and systems like it that many of you are developing.

When we talk about managing risk, most people intuitively understand the hazards of operating without due regard or in complete ignorance of the risks in their operations and organization.

Nevertheless, organizations seem to succumb to production, budget, or schedule pressures. Despite intuitive understanding, they are being ignorant or cavalier about the risks.

This is clearly a losing proposition that can lead to a high consequence event.

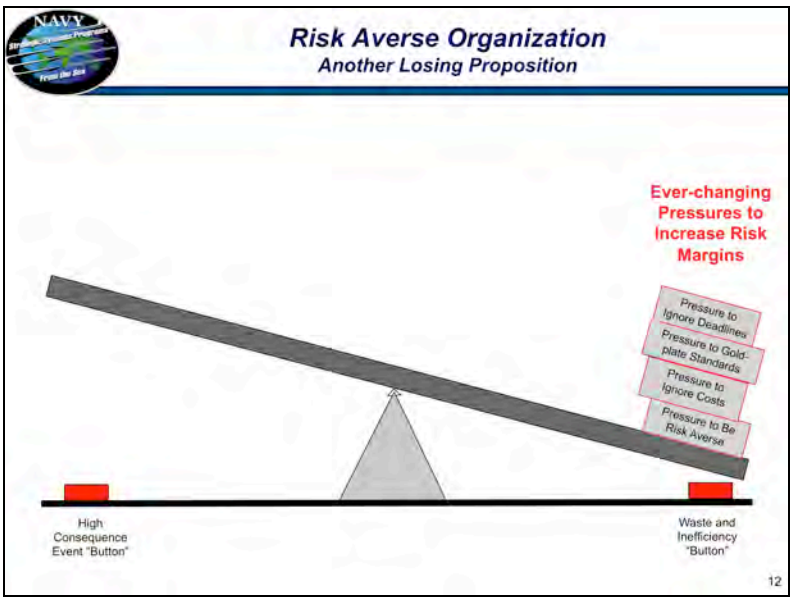


Figure 8

Dangers of Risk Averse organizations (*See Figure 8*)

However, fear of taking risk is not a winning proposition either. Desires to have impossibly high standards of operation, operating without regard to budgets or schedules, or armoring an organization against even a possibility of failure is indicative of risk aversion.

Ultimately, this losing proposition prevents us from obtaining the benefits of the technology, and worse, it wastes taxpayer money.

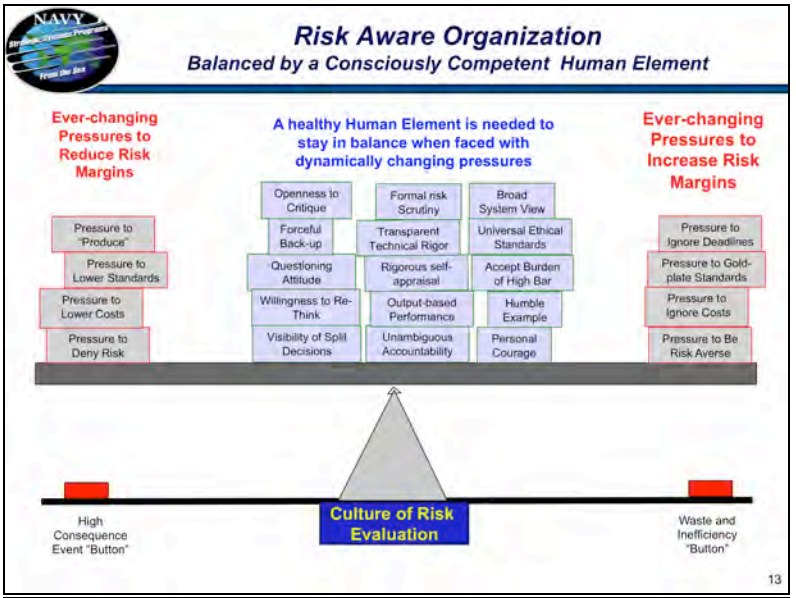


Figure 9

Risk Aware Organization (*See Figure 9*)

What we need is a risk aware organization. In this, each individual is empowered to engage his or her system with conscious competence, applying the collection of habits that we are emphasizing at SSP.

No one can predict how the strengths will gang together to allow us to avoid a high consequence event, but surely we are better able to balance between the pressures of production and the pressures to avoid any adverse outcome by arming ourselves with these strengths.

Conclusion

As you continue your efforts to improve our undersea capabilities, keep in mind that as our systems grow in complexity, the potential for error grows with it. Furthermore, these errors are not just an operator problem. Their foundations can be laid at any point in the lifecycle of the system.

To ensure our technology operates as intended in a safe and effective manner, you and your teams must have both technical and human element strength.

And finally, the basis of that human strength must be a culture of risk evaluation.

It is incumbent upon each of us, as stewards of incredibly useful yet potentially dangerous technology, to never satisfy ourselves that our past success will carry us forward.

> "Success is a lousy teacher. It seduces smart people into thinking they can't lose. And it's an unreliable guide to the future."
>
> *Bill Gates*

We must be vigilant for new problems, and thereby ensure that our people will be ready to solve them.

SUBMARINE TECHNOLOGY SYMPOSIUM

FUTURE UNDERSEA IMPERATIVES FOR THE INTEGRATED NAVY

RADM RICK BRECKENRIDGE, USN
NAVAL WARFARE INTEGRATION OPNAV N91

MAY 14, 2014

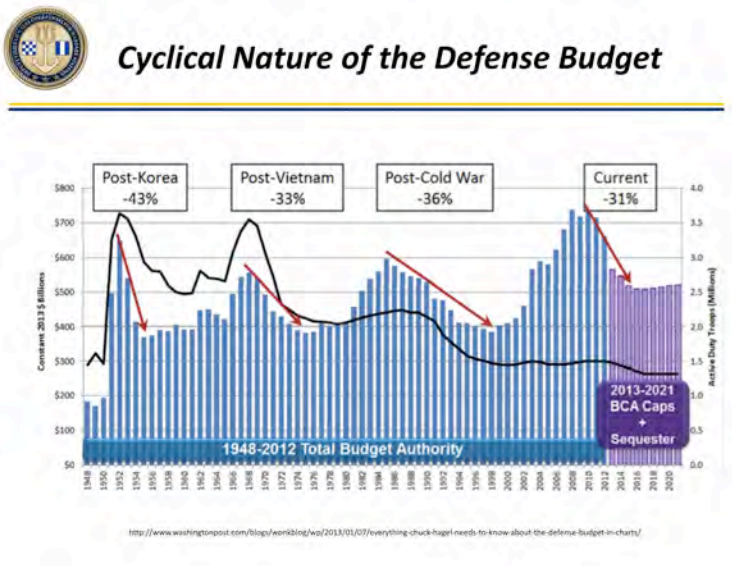
Editor's Note: Rear Admiral Breckenridge delivered this presentation by speaking directly from his slides without a prepared text script. In this case, the editorial opinion is that the slides hold all the information presented and are not simply outlines of a text presentation, therefore are presented in their stand-alone form.

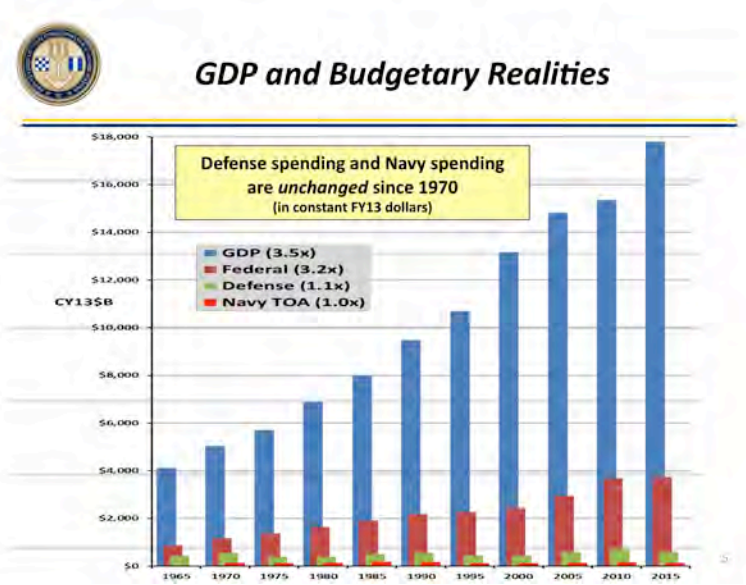
U.S. Historical Pendulum

1905:	Teddy Roosevelt Great White Fleet and *"Big Stick" diplomacy*
1912:	Woodrow Wilson first term: *"He'll keep us out of war"*
1917:	Wilson's *"War to end all wars,"* Pershing, Rickenbacker
1920:	*No* to League of Nations; Munich, Japanese Invasion, German invasions
1940:	Build-up; Pearl Harbor; WW II; N Africa, Italy, D-Day; Pacific, Leyte Gulf; Hiroshima
1945:	Post War demobilization and withdrawal, GI-Bill, Baby Boom
1948:	Marshall Plan, NATO, Berlin, Korea, H-bomb
1953:	Massive Retaliation, Hungary 1956, Suez 1956
1959:	Missile Gap, SSBNs, Cuban Missile Crisis, Flexible Response, 1973 War, Vietnam
1974:	Post Vietnam drawdown, Détente, Ostpolitik, Apollo-Soyuz
1979:	Russians in Afghanistan, Reagan Buildup, USS OHIO/NIMITZ, Pershing II
1989:	Post Cold War drawdown; Bosnia, Serbia, Blackhawk Down
2001:	9/11, OEF, OIF, GWOT
2009:	"Nation-building at home;" Syria, Iran, Ukraine, South China Sea
??	

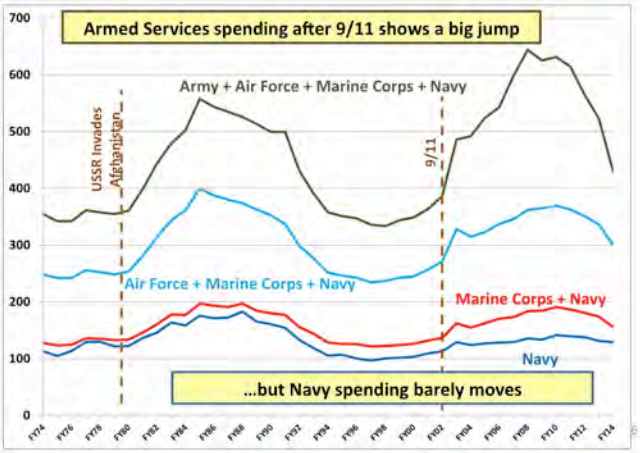
Probably Prudent to Plan for the Pendulum to Swing Again

3


Cyclical Nature of the Defense Budget
Post-Korea
-43%
Post-Vietnam
-33%
Post-Cold War
-36%
Current
-31%
2013-2021
BCA Caps
+
Sequester
1948-2012 Total Budget Authority
Constant 2013 $ Billions
Active Duty Troops (Millions)
http://www.washingtonpost.com/blogs/wonkblog/wp/2013/01/07/everything-chuck-hagel-needs-to-know-about-the-defense-budget-in-charts/


GDP and Budgetary Realities
Defense spending and Navy spending
are unchanged since 1970
(in constant FY13 dollars)
GDP (3.5x)
Federal (3.2x)
Defense (1.1x)
Navy TOA (1.0x)
CY13$B
$18,000
$16,000
$14,000
$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015

Defense Spending - Historical

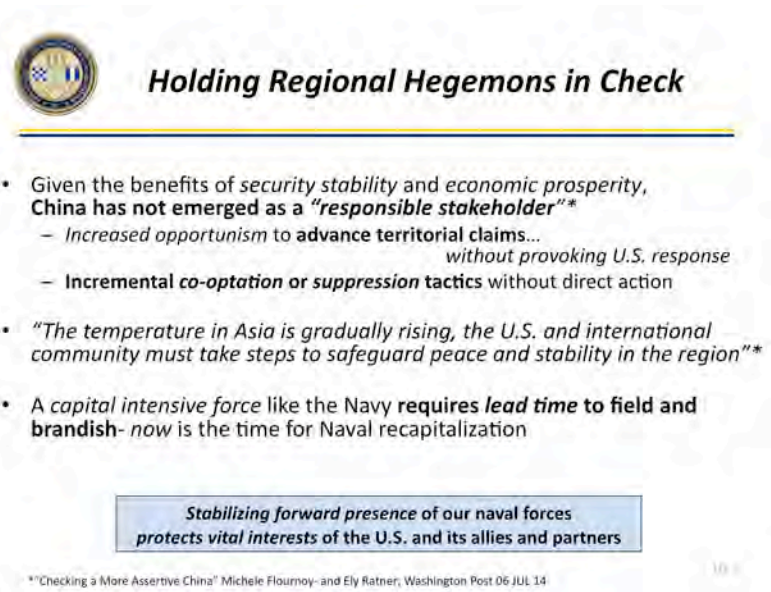


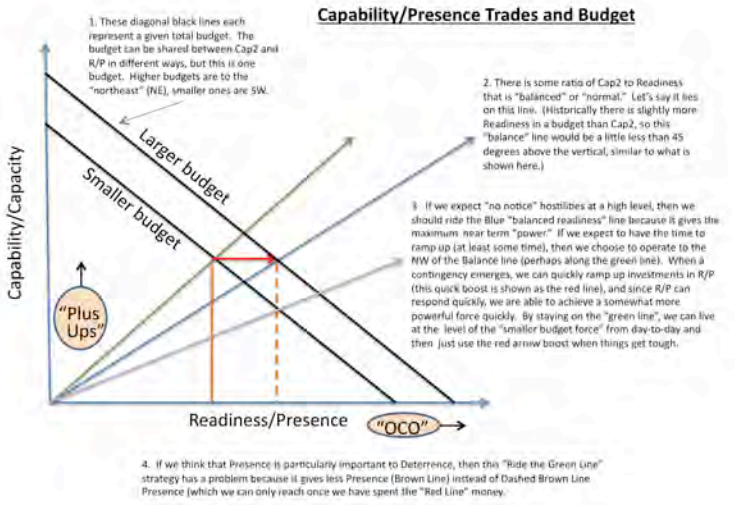
Global Forward Presence – *Stretches our Lean Forces (people) to the Max*

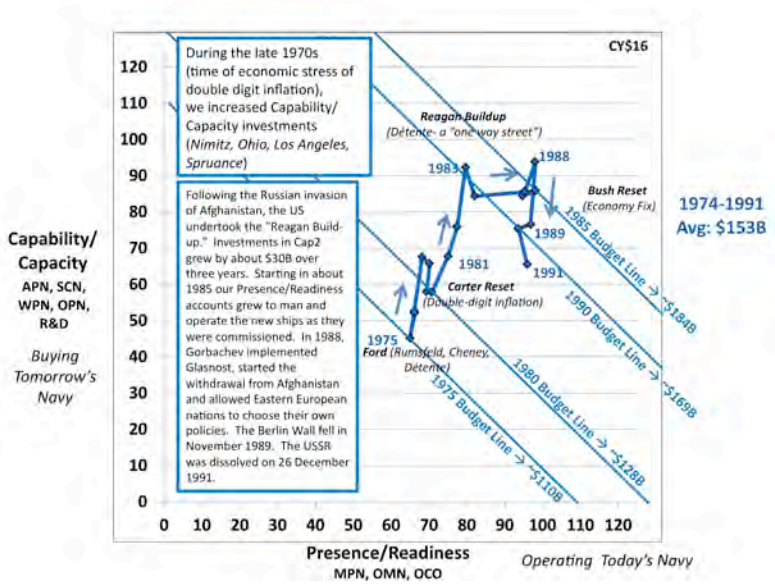
Transit Times (in days)	
East Coast - Suez Canal	15
East Coast - Strait of Hormuz	24
East Coast - Strait of Malacca	31
West Coast - Yokosuka	14
West Coast - Strait of Hormuz	32
West Coast - Strait of Malacca	23

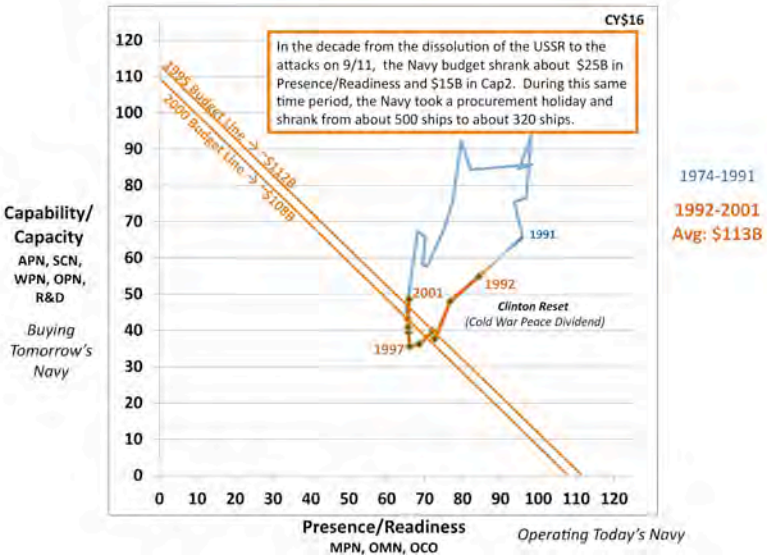
Place an arrow on a region of the globe where we can stand down

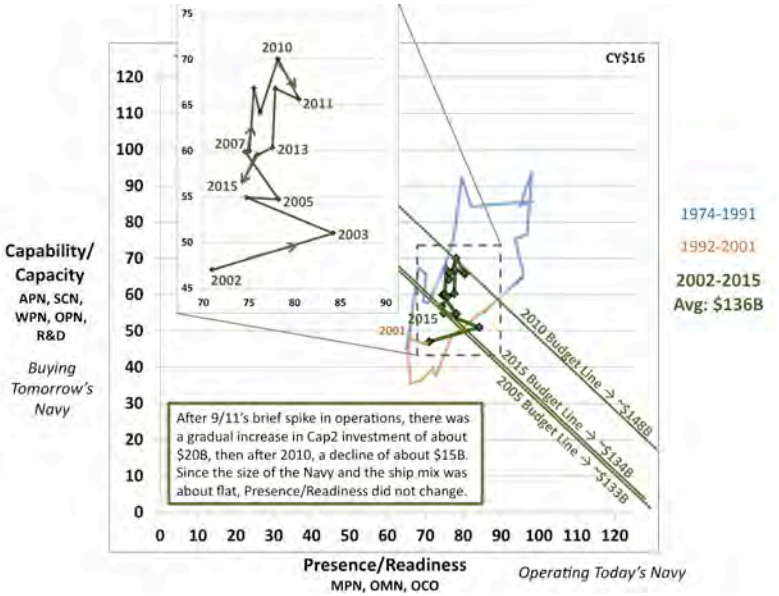

The Global Commons- Gut Check Time
President Wilson Calls for a Declaration of War, April 2, 1917
"International law had its origin in the attempt to set up some law which would be respected and observed upon the seas, where no nation had right of dominion and where lay the free highways of the world.... This minimum of right the German Government has swept aside...."
The Atlantic Charter, August 14, 1941
"...common principles in the national policies of [the U.S. and the U.K.] on which they base their hopes for a better future for the world....
Sixth, after the final destruction of the Nazi tyranny, they hope to see established a peace which will afford to all nations the means of dwelling in safety within their own boundaries, and which will afford assurance that all the men in all lands may live out their lives in freedom from fear and want....
Seventh, such a peace should enable all men to traverse the high seas and oceans without hindrance....
National Security Act of 1947
"The Navy shall be generally responsible for naval reconnaissance, anti-submarine warfare and the protection of shipping."
U.S. Navy Strategy "From the Sea" 1992
"With the demise of the Soviet Union, the free nations of the world claim preeminent control of the seas and ensure freedom of commercial maritime passage."
Defense Strategic Guidance 2012
"The maintenance of peace, stability, the free flow of commerce, and of U.S. influence in this dynamic [the Asia-Pacific] region will depend in part on an underlying balance of military capability and presence."
9

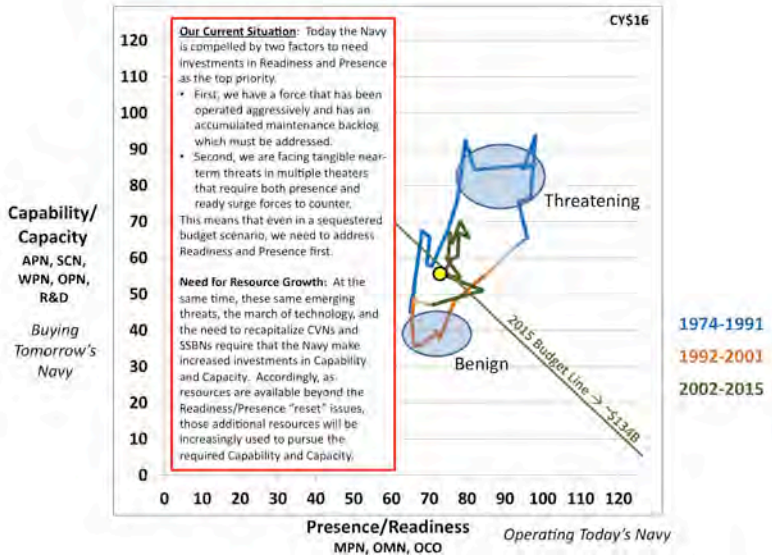

Holding Regional Hegemons in Check
• Given the benefits of security stability and economic prosperity, China has not emerged as a "responsible stakeholder"*
– Increased opportunism to advance territorial claims... without provoking U.S. response
– Incremental co-optation or suppression tactics without direct action
• "The temperature in Asia is gradually rising, the U.S. and international community must take steps to safeguard peace and stability in the region"*
• A capital intensive force like the Navy requires lead time to field and brandish- now is the time for Naval recapitalization
Stabilizing forward presence of our naval forces protects vital interests of the U.S. and its allies and partners
*"Checking a More Assertive China" Michele Flournoy- and Ely Ratner, Washington Post 06 JUL 14


Capability/Presence Trades and Budget
1. These diagonal black lines each represent a given total budget. The budget can be shared between Cap2 and R/P in different ways, but this is one budget. Higher budgets are to the "northeast" (NE), smaller ones are SW.
Larger budget
Smaller budget
2. There is some ratio of Cap2 to Readiness that is "balanced" or "normal." Let's say it lies on this line. (Historically there is slightly more Readiness in a budget than Cap2, so this "balance" line would be a little less than 45 degrees above the vertical, similar to what is shown here.)
3. If we expect "no notice" hostilities at a high level, then we should ride the Blue "balanced readiness" line because it gives the maximum near term "power." If we expect to have the time to ramp up (at least some time), then we choose to operate to the NW of the Balance line (perhaps along the green line). When a contingency emerges, we can quickly ramp up investments in R/P (this quick boost is shown as the red line), and since R/P can respond quickly, we are able to achieve a somewhat more powerful force quickly. By staying on the "green line", we can live at the level of the "smaller budget force" from day-to-day and then just use the red arrow boost when things get tough.
Capability/Capacity
"Plus Ups"
Readiness/Presence
"OCO"
4. If we think that Presence is particularly important to Deterrence, then this "Ride the Green Line" strategy has a problem because it gives less Presence (Brown Line) instead of Dashed Brown Line Presence (which we can only reach once we have spent the "Red Line" money.


CY$16
During the late 1970s (time of economic stress of double digit inflation), we increased Capability/ Capacity investments (Nimitz, Ohio, Los Angeles, Spruance)
Following the Russian invasion of Afghanistan, the US undertook the "Reagan Build-up." Investments in Cap2 grew by about $30B over three years. Starting in about 1985 our Presence/Readiness accounts grew to man and operate the new ships as they were commissioned. In 1988, Gorbachev implemented Glasnost, started the withdrawal from Afghanistan and allowed Eastern European nations to choose their own policies. The Berlin Wall fell in November 1989. The USSR was dissolved on 26 December 1991.
Reagan Buildup
(Détente- a "one-way street")
Bush Reset
(Economy Fix)
Carter Reset
(Double-digit inflation)
Ford (Rumsfeld, Cheney, Détente)
1975
1981
1983
1988
1989
1991
1985 Budget Line → ~$184B
1990 Budget Line → ~$169B
1980 Budget Line → ~$128B
1975 Budget Line → ~$110B
1974-1991
Avg: $153B
Capability/ Capacity
APN, SCN, WPN, OPN, R&D
Buying Tomorrow's Navy
Presence/Readiness
MPN, OMN, OCO
Operating Today's Navy
0 10 20 30 40 50 60 70 80 90 100 110 120


CY$16
In the decade from the dissolution of the USSR to the attacks on 9/11, the Navy budget shrank about $25B in Presence/Readiness and $15B in Cap2. During this same time period, the Navy took a procurement holiday and shrank from about 500 ships to about 320 ships.
1996 Budget Line → ~$112B
2000 Budget Line → ~$108B
Capability/ Capacity
APN, SCN, WPN, OPN, R&D
Buying Tomorrow's Navy
1974-1991
1992-2001
Avg: $113B
1991
1992
2001
1997
Clinton Reset
(Cold War Peace Dividend)
Presence/Readiness
MPN, OMN, OCO
Operating Today's Navy
0 10 20 30 40 50 60 70 80 90 100 110 120


CY$16
Capability/
Capacity
APN, SCN,
WPN, OPN,
R&D
Buying
Tomorrow's
Navy
Presence/Readiness
MPN, OMN, OCO
Operating Today's Navy
1974-1991
1992-2001
2002-2015
Avg: $136B
2010 Budget Line → ~$148B
2015 Budget Line → ~$134B
2005 Budget Line → ~$133B
After 9/11's brief spike in operations, there was a gradual increase in Cap2 investment of about $20B, then after 2010, a decline of about $15B. Since the size of the Navy and the ship mix was about flat, Presence/Readiness did not change.
2010
2011
2007
2013
2015
2005
2003
2002
2001


CY$16
Our Current Situation: Today the Navy is compelled by two factors to need investments in Readiness and Presence as the top priority.
• First, we have a force that has been operated aggressively and has an accumulated maintenance backlog which must be addressed.
• Second, we are facing tangible near-term threats in multiple theaters that require both presence and ready surge forces to counter.
This means that even in a sequestered budget scenario, we need to address Readiness and Presence first.
Need for Resource Growth: At the same time, these same emerging threats, the march of technology, and the need to recapitalize CVNs and SSBNs require that the Navy make increased investments in Capability and Capacity. Accordingly, as resources are available beyond the Readiness/Presence "reset" issues, those additional resources will be increasingly used to pursue the required Capability and Capacity.
Capability/ Capacity
APN, SCN, WPN, OPN, R&D
Buying Tomorrow's Navy
120
110
100
90
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100 110 120
Presence/Readiness
MPN, OMN, OCO
Operating Today's Navy
Threatening
Benign
2015 Budget Line -> -$134B
1974-1991
1992-2001
2002-2015

Key Thoughts

- Future security environment will place ***increased*** **reliance on stabilizing Naval forward presence** to deter aggressive regional behavior
  - Tangible near-term threats in multiple theaters require both presence and ready surge forces to counter
  - Operations/Readiness accounts require increased funding to buy down accumulated maintenance backlog
  - Resiliency of the bench is flagging and needs "reset"
- **Now is the time to *recapitalize Naval force structure*** and ***power projection*** capabilities
  (*even in the midst of an overarching DoD declining Budget reset*)
  - National response to *mounting regional hegemons* demands action *now* (inherent lag time)
  - Navy Shipbuilding Program: lean, cost-efficient, yet *insufficient* to sustain Fleet numbers
  - History shows the shipbuilding industry ideal means for *national economic revitalization*
- **SSBN recapitalization** will require supplemental funding
  - Episodic nature is very unique (*"every other generation"*)
  - National economy is beneficiary of 12-year class extension- *no further delay is possible*
  - National Security *Return on Investment lasts through the 2080s*
  - If SSBN funded within Navy TOA: disruptive *cost inefficiency* absorbed throughout the entire shipbuilding program (***effective 43% cut from $14B to $8B***)
  - If SSBN funded across DoD: cost would be spread across more than $500B budget (***effective 1.2% cut***)

Navy budget requirements are uniquely "off-cycle" and must increase as DoD contracts

FEATURES

CAPITOL HILL FORUM

AIR FORCE ASSOCIATION, NATIONAL DEFENSE INDUSTRIAL ASSOCIATION AND RESERVE OFFICERS ASSOCIATION

THE STRATEGIC CHALLENGES FACING THE U.S.: THE ROADMAP AHEAD

Admiral Cecil Haney, Commander, U.S. Strategic Command

MR. PETER HUESSY: Good morning. On behalf of NDIA and AFA and ROA, I'd like to welcome you to this next of our series of seminars on nuclear deterrence, arms control, missile defense and defense policy.

I want to thank our friends from the embassies of Russia, Great Britain and Austria who are here today joining us. I also want to thank our military guests and give a vote of thanks to the Admiral's staff from both here in D.C. and in Omaha for the wonderful work and cooperation they've shown with us in putting this together. I'm honored to have Admiral Cecil Haney here for his first breakfast seminar speech. We have had every STRAT Commander and SAC Commander since 1983 here. Many of you may know that the Admiral is a native of Washington, D.C. As he told us, he grew up about 13 blocks from the club here. He went to the Naval Academy and graduated in 1978. He was assigned to the USS JOHN C. CALHOUN, USS FRANK CABLE, USS HYMAN RICKOVER, USS ASHVILLE and Submarine Squadron 8. And he culminated in the command of USS HONOLULU.

His shore duties included Administrative Assistant for Enlisted Affairs at the Naval Reactors, Congressional Appropriations Liaison Officer for the Secretary of Defense, Deputy Chief of Staff of Plans, Policy and Requirements for the U.S. Pacific Fleet,

and Director of Submarine Warfare Division, N87, and the Director of Naval Warfare Integration Group, as well as the Deputy Commander of U.S. Strategic Command. And prior to this assignment, he was the Commander of the U.S. Pacific Fleet.

He holds a Master's degree in engineering, acoustics and systems technology from the Naval Post-graduate School, and a Master's degree in national security strategy from my old haunting place, the National Defense University. Admiral, on behalf of our sponsors, our guests and AFA, ROA and NDIA, I want to thank you for taking the time out of your very busy schedule to come and talk to us here about these very, very important issues. Would you give a warm welcome to the Commander of U.S. Strategic Command, Admiral Haney?

ADM. HANEY: Well, good morning. Peter, thanks for that kind introduction and for allowing over the span of I think a week, two of us in a Navy uniform to show up here to talk about matters. Vice Admiral Terry Benedict was here very recently. I can't thank you enough for hosting these kinds of events. And for just thinking about having these breakfast seminars on one of my favorite topics, strategic deterrence and issues that are facing not only our military but our nation at large. It's a pleasure to join you here on behalf of the team I lead, those soldiers, sailors, airmen, marines and civilians, that work for or at U.S. Strategic Command. So greetings from the heartland of the United States of America.

It's great to be here representing my command that's located just south of Omaha, Nebraska, home of the College World Series.

As the Commander of U.S. Strategic Command, I thought I would discuss how I see the strategic environment; and my missions and priorities. I will focus significantly on sustainment, maintenance and modernization of our strategic deterrent; and finally, my concerns and approaches regarding our strategic nuclear deterrent.

I'm sure that many here in this audience would agree with me today that our nation is dealing with a global strategic environment that is complex, dynamic and perhaps more-so than at any time in our history. Advances in state/non-state military capabilities

continue across the air, sea, land and space domains, as well as in cyber-space. The space domain is becoming ever more congested, contested and competitive.

Worldwide cyber-threats are growing in scale and in sophistication. Nuclear powers are investing long-term in wide-ranging military modernization programs. Proliferation of weapons and nuclear technologies continues. Weapons of mass destruction capability delivery technologies are maturing and becoming more readily available. No region of the world is immune from potential chemical, biological, radiological or nuclear risk.

Terrorist threats remain a source of significant ambiguity, and the threat of home-grown violent extremists remains a concern. Our world today is characterized by violent extremist organizations, significant regional unrest, protracted conflicts, budgetary stresses, competition for natural resources, and the transition and diffusion of power among global and regional actors. To borrow from the words of Chairman General Dempsey, no matter how much we may wish it, the world is not getting safer.

We have seen instability and unrest around the globe: Syria, Libya, Iraq, Mali, Sudan, Nigeria, and the list goes on. Ukraine is far from settled. States and non-state actors alike have access to capabilities previously limited to only state actors with significant resources. While strategic attacks against the United States remains remote, we must remain vigilant and capable to address the strategic threats in the current security environment with effective capabilities, with an effort that includes our whole of government, and of course our allies and partners.

I am sure most of you are monitoring the situation, for example, with respect to Russia and Ukraine following, of course, the Crimea crisis. In light of increasing tensions, Russia has also been busy exercising and demonstrating its strategic capabilities, reaping the benefits of decades of modernization. Just recently on the 8th of May, for example, Russia conducted a major strategic forces exercise involving significant nuclear forces and associated command and control in just six months since the last one back in October. Both exercises were aired on YouTube, albeit in Russian, and showed President Putin ordering his commanders into action.

Additionally, we have seen significant Russian strategic aircraft deployments in the vicinity of places like Japan, Korea and even our West Coast. As President Putin has articulated, Russia continues to modernize its strategic capabilities across all legs of its triad. And open sources recently cited the sea trials of its latest SSBN, the testing of its newest air-launched cruise missile, and modernization of its intercontinental ballistic force to include its mobile capability in that area. The good news is that Russia continues, though, to follow the New START Treaty, which has associated notifications and access, important trust measures for both of our nations.

As expected, we pay close attention to China, given its economic growth and associated improvements in military capabilities, including nuclear weapons, space and cyber-space, as they work to solidify their position in the world. For example, they are modernizing their strategic forces to include fielding more survivable road-mobile intercontinental ballistic missiles, enhancing their silo-based ICBMs, as well as developing a new ballistic missile submarine and the associated strategic missiles for that platform. They are continuing to develop space capabilities.

As you know, the Chinese are developing multi-dimensional space capabilities, and fortunately haven't hit anything since 2007 when they launched that anti-satellite weapon hitting a satellite and leaving a tremendous amount of debris in low earth orbit spinning close to the world's precious space assets, including the International Space Station. Finally, China continues to conduct exploitation of computer networks for commercial advantage while securing their economic interests around the globe. Many of these details were recently provided in the DoD report to Congress, which is available to you on the Internet. But given this audience, you probably have already read that report cover to cover.

North Korea continues to maintain a threatening posture while working to develop strategic capabilities to preserve Kim Jong-un's dynasty. They have advanced their nuclear capabilities and produce enough fissile material for several weapons. They are pursuing long-range ballistic missiles and are developing offensive

cyber capabilities, using these emerging strategic capabilities for both internal and external leverage.

Time will tell with respect to the negotiations with Iran, but it's no secret of their interest to have nuclear weapons capabilities. They are pursuing a space launch vehicle, which could serve as a test-bed for developing intercontinental ballistic missile technologies. And like North Korea, they are also working hard to develop their cyber capabilities.

One can't have a nuclear weapons discussion without also mentioning India and Pakistan. India is developing two intercontinental ballistic missile systems, extending New Delhi's missile force range, while continuing the development of their ballistic missile submarine and submarine-launched ballistic missiles, which have recently been in the news. Pakistan continues to develop and upgrade their nuclear delivery systems for a full range of platforms, including both ballistic and cruise missiles.

So this paints a picture of the strategic environment, but it doesn't include other challenges to the global security environment that further stress our joint military forces. I've already mentioned some of these, such as Syria, Libya, and several African nations including the endless list of barbaric atrocities by terrorist organizations such as Boko Haram. In April al-Qaeda leaders held an open air meeting in Yemen, reminding us of their radical beliefs.

And we're seeing the impact of years of political division in Thailand, a country now under martial law, and general elections are likely to be held off for at least another year. Even now the world is watching as the situation in Iraq is unfolding. And, of course, I would be remiss if I didn't talk about our fiscal environment.

I do remind my team today our national debt is more than $17.5 trillion. And, of course, reducing our debt and improving our economy are also critical to our national security. Prioritizing resources to meet our goals requires a thoughtful assessment of national priorities in the context of fiscal realities.

Today's budget environment remains a concern as we look to sustain and modernize our military forces, including our strategic

capabilities. While the passage of the two year Bipartisan Budget Act of 2013, and the 2014 omnibus appropriations, provided us with some relief, sequestration is and will continue to have significant impacts on our strategic capabilities now and into the future, critical to U.S. Strategic Command as we provide unique and foundational capabilities to the defense of our nation.

While we are taking steps to prepare for the future, this creates significant uncertainty and will put a squeeze on both our readiness and, of course, our incredibly talented people. While our workforce is resilient, they still recall the combined effects of a hiring freeze, furloughs and other force reduction measures that continue to stress the human element of U.S. Strategic Command capabilities. We continue to work with Congress and commit to continue working closely to ensure our nation's strategic requirements are understood.

Against this dynamic and uncertain backdrop, U.S. Strategic Command's mission is to partner with our other combatant commands to deter and detect strategic attack against the United States of America and our allies, and to defeat those attacks if deterrence fails by providing the President of the United States options. Your Strategic Command provides an array of global strategic capabilities to the joint force through the nine assigned unified command plan missions, including: strategic deterrence, space operations, cyber space operations, joint electronic warfare, global strike, missile defense, intelligence, surveillance and reconnaissance, combating weapons of mass destruction, and analysis and targeting.

These assigned missions are strategic in nature, global in scope and intertwined with capabilities of our joint military forces in the interagency and the whole of government. This requires increased linkages and synergies at all levels to bring integrated capabilities to bear through synchronized planning, simultaneous execution of plans, and coherent strategic communications. Your Strategic Command manages this diverse and challenging activity by actively executing a tailored deterrence and assurance campaign plan, and by executing my command priorities.

They include: providing a safe, secure, effective and credible nuclear deterrent force; partnering with other combatant commands, the inter-agency network and our allies and partners to reduce uncertainty in the strategic and security environments, and of course, win today; to address the challenges in space and to build cyber-space capability and capacity; and to prepare for uncertainty. While I'd love to cover each one of these today, I will focus on the necessity of sustaining and modernizing our strategic nuclear deterrent. I would especially appreciate an opportunity to dig deeper into space and cyber-space, but given the amount of time I will not, especially since these two get a lot of attention in other dialogues and forums today.

Particularly, I'll ask an audience, even one like this one, what makes up the strategic nuclear deterrent capability this country relies on? Frequently I get the short answer, that it involves simply the triad: ICBMs, submarines, bombers. Ninety percent of the time the conversation stops there.

Our strategic nuclear capabilities actually include the synthesis of dedicated sensors, assured command and control, the triad of delivery systems, nuclear weapons and their associated infrastructure, and trained and ready people. I will cover each of these. First, sensors.

Our integrated tactical warning and attack assessment network of sensors and processing facilities provide critical early warning and allows us to select the most suitable course of action in rapidly developing situations. While the Defense Support Program, commonly called DSP, is approaching the end of its life, the Space-Based Infrared System, or SBIRS program, is on track to provide continued on-orbit capability. The survivable and endurable segments of these systems, along with the early warning radars, are being recapitalized and are vital to maintaining a credible deterrent.

Assured and reliable command and control is critical to the credibility of our nuclear deterrent. The aging NC3 system continues to meet its intended purpose, but risks to mission success are increasing. Our challenges include operating aging

legacy systems and addressing risks associated with today's digital security environment.

Many NC3 (national command and control and communications) systems require modernization, but it's not easy to simply build a new version of the old system. Rather, we must optimize the current architecture while leveraging new technologies so that our NC3 systems interoperate as the core of a broader national command and control system. We are working to shift from point-to-point hard wired systems to a networked IP-based national command and control and communications architecture that will balance survivability and endurability against a diverse range of threats, deliver relevant capabilities across the range of interdependent national missions, and ultimately enhance presidential decision time and space.

Now I won't go through the laundry list of programs, but many of you know what some of those are. They involve terminals, voice conferencing, air-to-ground communication networks, low frequency communication upgrades to some of our command and control platforms such as the E-4B, and communication upgrades to programs such as our B-2 platforms as well as our E-6B, the service life extension programs. We must continue to move forward with investments to allow appropriate and timely command and control from the president all the way down to the operating forces.

Getting back to that smaller portion of the nuclear triad, per the 2010 Nuclear Posture Review, it states, quote, "Retaining all three legs will best maintain strategic stability at reasonable cost while hedging against potential technical problems or vulnerabilities," end-quote. The commitment to the triad was reinforced in the U.S. Nuclear Weapons Employment Planning Guidance the president issued in June of 2013. U.S. Strategic Command executes strategic deterrence and assurance operations with, of course, the ICBMs, the ballistic missile nuclear submarines, and the nuclear-capable heavy bombers. Each element of the nuclear triad provides unique and complementary attributes to strategic deterrence, and the whole is greater than the sum of the parts.

So first, our ICBM force, which promotes deterrence and stability by filling a responsive and resilient capability that imposes costs and denies benefits to those who would consider to threaten our security. Though fielded back in 1970, the Minuteman III ICBM is sustainable through 2030 with smart modernization and recapitalization investments. The Air Force Ground-Based Strategic Deterrent Analysis of Alternatives is studying a full range of ICBM concepts which will shape our land-based deterrent force well beyond 2030.

Recapitalizing our sea-based strategic deterrent force is my top modernization priority, and I'm committed to working closely with the Navy on this program. The Navy's SSBNs and Trident II D-5 ballistic missiles constitute the triad's most survivable leg, and the assured response they provide underpins our nuclear deterrent. This stealthy and highly capable force is composed of two major elements, the missile and the delivery system. Both are undergoing needed modernization.

With respect to the missile, we are extending the life of the D-5 missile to be capable until after 2040. And with respect to the submarine that delivers these missiles, the Ohio-class submarine has already been extended from 30 to 42 years of service. No extension is possible and these submarines will start leaving service in 2027. Now as a submariner, I have never been to sea on a submarine that's 40 years old, much less 42. As such, the Ohio replacement program must remain on schedule, no further delay is possible.

Heavy bombers: while our nation relies on the long-range conventional strike capability of our heavy bombers, the nuclear capability of the B-52 and B-2 bombers continue to provide us with flexibility, visibility and rapid hedge against technical challenges in the other legs of the triad. Our B-52 and B-2 training flights assure our allies and partners and underscore our security commitments. Maintaining an effective air delivery standoff capability is vital to meet our deterrence commitments and to effectively conduct global strike operations in the anti-access, access-denial environments.

Planned sustainment and modernization activities, to include associated nuclear command and control and communications, will ensure a credible nuclear bomber capability through 2040. Looking forward, a new highly survivable penetrating bomber is required to credibly sustain our broad range of deterrence and strike options beyond the lifespan of today's platforms. Similarly, I believe a follow-on nuclear cruise missile is necessary to replace the aging air-launched cruise missile.

Nuclear weapons and their supporting infrastructure underpin our nuclear triad. All warheads today are on average nearly 30 years old. While surveillance activities are essential to monitoring the health of our nuclear warheads, life extension programs are key to sustaining our nuclear arsenal into the future, mitigating age-related effects, and incorporating improved safety and security features.

The Department of Defense and the Department of Energy must continue to work together to keep the multi-decade plan for a modern, safe and secure and effective nuclear stockpile. The Nuclear Weapons Council's 3+2 plan, so named because of the long-term result is three ballistic missiles and two air-delivered warheads, provides a framework to sustain a nuclear force that addresses both near-term technical needs and future triad capability requirements.

As mentioned, Vice Admiral Benedict, I think, covered with you the W-76 Stack 1 life extension program that's in progress to support the submarine leg of the triad. This is particularly important as the W-76 represents the majority of our survivable strategic deterrent force. And the Air Force and the National Nuclear Security Administration, which I'll refer to as NNSA, continue to make progress on a full life extension for the B-61 gravity bomb, critical to our strategic capabilities and extended deterrent commitments. Both life extension programs are necessary to maintain confidence in the reliability, safety and intrinsic security of our nuclear weapons.

Looking to the future, we continue to work with NNSA on the feasibility of an interoperable nuclear package for our ballistic missile warheads and options for sustaining our air-delivered

standoff capabilities. Sustaining and modernizing the nuclear enterprise infrastructure is crucial too, to our long-term strategy. Continued investment in the nuclear enterprise infrastructure is needed to provide critical capabilities that meet our stockpile requirements.

So what about people? To operate this nuclear deterrent force now and into the future requires skilled operators. It is the professionalism and the ability of our men and women in and out of uniform that gives our military that decisive advantage. They do everything from strategic planning to mission execution, along with maintaining and sustaining our weapons. People too are the weapons system that must be invested in and sustained, and will grow into our next generation of leaders to bring our new SSBNs, ICBMs and long-range strike bombers online or to conduct life extension programs, for example, in our laboratories.

When you look at the success of our deterrent, demonstrated most recently in the test you heard about from Vice Admiral Terry Benedict, of how earlier this month we successfully test launched two D-5 missiles, marking more than 150 successful test launches, this success is made possible by all the highly skilled professionals that are behind our strategic capabilities. As such, I am proud to lead the team of dedicated professionals who every day ensure our nation has a safe, secure and effective and credible deterrent while supporting U.S. Strategic Command's other eight missions.

Although our nuclear arsenal is smaller than it has been since the late '50s, today's nuclear weapons systems remain capable and will serve the United States well into their fourth decade. In recent years, the percentage of spending on nuclear forces has gradually declined to only 2.5 percent of total DoD spending in 2013, a figure near historical lows. Today's nuclear force remains safe, secure and effective despite operating well beyond their original life expectancies.

The nation faces a substantive multi-decade recapitalization challenge, and we must continue investments towards that effort. Our planned investments are significant, but are commensurate with the magnitude of the national resource that is our strategic deterrent. If we do not commit to these investments, we risk

degrading the deterrent and the stabilizing effect of a strong and capable nuclear force.

You might ask if we need to invest in this capability. And I hope from my comments today you understand my answer is, absolutely. The cost to recapitalize is less than the potential cost of an ineffective deterrent. We cannot afford to take the risk of not getting this right.

As I mentioned earlier, uncertainty and complexity dominate the security landscape today. Our actions must make it clear to our allies and adversaries that we are in a position to impose costs, deny benefits, and create the conditions in which the adversary knows he will not succeed in a conflict against the United States. While total deterrence against any particular adversary is never guaranteed, I am confident that today our strategic deterrent efforts are working and will deter nuclear attack against the United States and its allies. But we must not delay modernization if we are to meet our future demands.

To quote the Secretary of Defense, "We also have to remember that every day we help prevent war, that's what we are about. And we do that better than anyone else". Thank you for your time today and I welcome your questions.

MR. TODD JACOBSON: Todd Jacobson, Nuclear Security and Deterrence Monitor. I wanted to ask you about the 3+2 strategy. Yesterday the Senate Energy and Water Appropriations Subcommittee zeroed out funding for a study on the cruise missile warhead replacement. Previously Congress has raised a lot of questions about the interoperable warhead approach. How confident are you—or maybe I should rephrase that. Are you concerned about Congressional support for the 3+2 strategy and how can that be overcome?

ADM. HANEY: You have drilled down into an important question, the business of funding and execution of the 3+2 strategy. I won't speculate on where Congress will go at the end of this journey, but I will say as we do this balance of where our

funding is relative to sequestration and what have you, we just have to be mindful of what it means to have a strategic deterrent that also has an air leg associated with it. As I stated earlier in my remarks, that's an important facet of our deterrent, to have that capability, to have that standoff capability now and well into the future.

MR. GREG THIELMANN: Greg Thielmann of the Arms Control Association. Thank you, Admiral, for your remarks. You mentioned the flexibility and visibility of our nuclear-capable heavy bomber force. And it seems like that was demonstrated recently with the deployment of the B-2s and B-52s to Europe. Given that context, I wonder if you could explain what additional value is provided that comes from the tactical nuclear weapons we still have in Europe?

ADM. HANEY: First of all, the bomber assurance and deterrence missions that we do quite frankly around the globe, are not just a demonstration of our capability and flexibility, but it's also to work closely with our allies in terms of that capability. So we have those scheduled out throughout the year and execute that with team of professionals. As you have discussed, the extended deterrence piece regarding our program, that is also an important critical part of our work with our key allies and partners. So that is also a very important piece of deterrence at large and an area that I also support.

MR. TOM COLLINA: Thank you, Admiral. Tom Collina of the Arms Control Association. To follow up on an earlier question on the air-launched cruise missile. Can you elaborate a little bit more on the importance of having a standoff missile, particularly on a bomber, a new bomber, that is designed to be a penetrating bomber? Why—what is the importance of a standoff missile in the context of a new penetrating bomber, particularly when the United States has other abilities for standoff, for example ICBMs and submarine-based missiles? What is the specific mission need

going forward with the air-launched cruise missile, particularly as you've described the budget conflicts ahead.

ADM. HANEY: Thank you for that question. When you look at the air leg, you can more simplistically come down to if you had all the stealth you could possibly have in a platform, then gravity bombs would solve it all. The reality is, just as we have seen proliferation of anti-access, access-denial capability and developments, that we have to be able to confront the uncertain future that we are a part of. And the business of having standoff and stealth is very important to our nation as we look at how long something like this long-range bomber will provide this nation well into the future.

Who would have thought the B-52s we're flying today—the B-52 Hotels—built in 1962 would still be capable well outside its advertised lifespan of about 30 years? It is still out there doing the mission, but it has standoff capability even though it doesn't have the exquisite stealth capabilities that our B-2 platforms have. Now I won't go into the types of planning we do at U.S. Strategic Command in terms of matching capabilities against targets so that we can hold the right things at risk if called upon, because that too is an important part of our deterrent calculus. But I would say to you that we would have to be careful with trying to balance this and say we don't have a need for a standoff capability just because we have plans for a long-range bomber with stealth characteristics. Because it is a certain quantity of stealth that you're trying to rely on well outside, perhaps, even the lifespan predicted for that platform today.

And the second piece I'd like to really articulate here is when you look at the capability we have today, that was worked by professionals from the '70s and early '80s, and think about just that small percentage that I talked about here today that has sustained our deterrent, whether it's submarines, whether it's the bombers or the ICBMs, that yes of course have had some modernization, we are still living on that half-life of that great work that was done. This stuff is designed well and fortunately has lasted a long time. We shouldn't forget that piece. And even as we

look at the future, it's hard for me to give you an exact figure. But when you look at going through our modernization program, which we don't do before it's time, we're still talking about a percentage of Department of Defense funding that's not, in my opinion, out of spec, particularly when you consider the risks associated with not getting that equation right for our future.

MR. JEFF TRAUBERMANN: Jeff Traubermann from Boeing. Thanks very much for being here. Given that complex security landscape you described, could you maybe elaborate a little bit more on the challenges you see of STRATCOM being both a supported command in your strategic mission, as well as those other mission areas where you're in a supporting role—the particular challenges you see in conducting those multiple mission areas?

ADM. HANEY: Thank you for that question. When you look at the various mission areas most days of the week I'm supporting combatant commands in a lot of those mission areas. But when you look at how the world is broken up into these geographical commands, that works well if you have a very localized fight. But when you look at the sophistication of potential adversaries in areas like cyber, areas like space, for example, they aren't able to be broken up into chunks like that. The ability for an enemy to have an impact on the continental United States from miles away tends to pull in, in any threat, multiple combatant commands.

If we're looking at a missile defense scenario, perhaps associated with Kim Jong-un in the future, you've clearly got to have Pacific Command, Northern Command and Strategic Command as a minimum involved in that particular scenario for any kind of campaign in that nature. So I think what you're seeing and sensing is the integration of our combatant commands. And we tend to work very closely with deliberate planning and with various operations to further glue us together so that as the need comes up, we can muster and support—or supporting or supported—in order to get the job done. And that in itself is about agility. It's about our

ability to work effectively and efficiently for the United States of America, particularly when you look at how far we've come in joint warfare at large, but particularly important today given the threats today and into the future. So I should say, it doesn't give me a headache. I enjoy that part.

MR. : Sir, as Jeff said, thank you very much for joining us. It has really enriched our seminar season here. You've alluded to space briefly. You said you weren't going to elaborate, we certainly understand that. But could you perhaps say a few words about space resilience—I know that's a topic that has been of significant interest recently—and perhaps make comments specifically about the systems? You did mention Space-Based Infrared , how that fits into resilience?

ADM. HANEY: It's amazing how dependent we all are as citizens on space. And every day we tend to use more and more of it, expect more and more out of it. But what I think we don't realize, quite frankly, is what it takes— not in this audience, perhaps—but as the country at large, to keep that capability we've grown accustomed to of having assured access day in and day out.

So it is important as we work—I mentioned the ASAT test, anti-satellite test in 2007. When we look at capabilities that others are working at developing and what have you, the business of thinking we would have this assured access without some effort is one that we in the United States of America have to remain focused on. So with that, this term resiliency—short word, a few syllables—but what does it mean and how do we get there? The whole business of having capabilities that can do what we need it to do, such as the SBIRS piece you discussed, but across all of what we use space for in our joint military network-centric method of fighting, it is important that we have innovative solutions that complicate any potential enemy's approach to taking us on in that business. And that's the work we are continuing to do and we must continue to invest in so that we can continue to have that

access assured for our US of A in general, but of course for our military capability and our deterrent capability as well.

MR. HUESSY: Admiral, could you elaborate a little bit on two issues with respect to missile defense? One is the challenges you face, and the value of missile defense to our overall deterrent posture? So the challenges in missile defense that you face, and then what are the values that missile defense gives you in terms of the overall mission?

ADM. HANEY: I know you've perhaps had Lieutenant General Dave Mann here not too long ago as well. And we commonly think we're all on the same page in that regard, of the challenge being to ensure we can keep up with the threats at hand. And as we work to execute the master plan, if you will, in getting there—the piece of getting our kill vehicle technology, particularly as we look at ground-based interceptors, right so that we can take on those kinds of threats we expect from nations such as North Korea and Iran, being able to do that effectively.

And as I mentioned, in terms of that cycle of life for strategic deterrence, the same business for missile defense, you've got to be capable to sense it. You really want the intelligence apparatus to be far to the left of that. You want to be able to move the information so that then you can allow our capability to do its business from the standpoint of ground-based interceptors, SM, Standard Missiles, to THAAD and what have you, in an integrated and synchronized fashion. So we continue to practice that. We continue to work to test that capability, as I'm sure Dave Mann talked about here. And so that piece, of continuing to work that is a priority.

The challenges in discrimination is also way up there. So this business of working the kill vehicle technology and being able to have the requisite sensing for discrimination for advanced threats is high on the list of getting at those challenges.

MS. CHERYL PELLERIN: Thank you, Cheryl Pellerin with American Forces Press. I was wondering if you could say something about your approach to cyber and some of your challenges?

ADM. HANEY: Well as I mentioned here, one of my priorities is to work hard to build our cyber-space capability and capacity. When you look at the cyber domain and U.S. Strategic Command, I have a sub-unified command, Cyber Command, that works for me, Admiral Mike Rogers, following in the footsteps of General Keith Alexander. So when it comes to doing the operational and tactical work, U.S. Cyber Command works hard at doing that. We at U.S. Strategic Command work in conjunction with them as we look to the future in terms of advocating for our necessary capability and then working to integrate it in a global sense, not just a regional kind of sense in terms of things.

As you know, cyber-space requires us to have the requisite defense capability in that space, given again like outer space, an area that we critically rely on for our country and, of course, how we fight as a joint military force. So having the defense piece of that well understood and integrated from the ground up as we build systems, as well as how we operate those systems with the requisite talent that is experienced in that battle space, is clearly important on that list. And then, as we look at having to respond to things offensively, that we also have the requisite talent and capability to do so if called upon. So this dimension in cyber space is critically important, and I'd be remiss if I didn't talk about preventing the exploitation of the critical work that goes on, for example, here in the United States of America in research and development and trade, what have you. It spans the whole of government, as far as I'm concerned, that preventing that exploitation is very important for our country now and into the future.

MR. PETE TRAVOR (ph): Peter Travor—In your travels, have you gotten a sense of how your counterparts look upon the capabilities of your command with regard to their strategic thinking?

ADM. HANEY: Thank you for that question. Interesting you bring it up. I was Pacific Fleet Commander before this job, and I was making trips through places like Australia, Japan and the Republic of Korea, South Korea. And near the end of that tour they were very interested in where I was going after that last swing through their neighborhood.

Since then, and in the short time I've been Commander of U.S. Strategic Command, I've had the chief of defense from the Republic of Korea, Admiral Choi, come through Strategic Command headquarters at Offutt Air Force Base, Nebraska. I've had General de Villiers, the equivalent there from France come through. And I'm expecting another visitor from South Korea here within a month. So it's not just me going to them, they also come to U.S. Strategic Command because they are interested, and they understand the importance of our alliance and how we do strategic deterrence and assurance for them.

And we've had very intricate discussions, as I say, since I've been in command here, with both the French and the Republic of Korea. I have a trip planned both for the European side of things as well as to Australia for this year to continue some of those discussions. And of course my teams are working through some of the combined planning with a variety of our allies in particular. So there's quite a congruency, if you will, in terms of the work we do at U.S. Strategic Command and working in conjunction with our allies and partners.

MR. HUESSY: Admiral Haney, thank you so much for a remarkable speech.

Thank you, sir, for an extraordinary set of remarks, wide-ranging, and we will invite you back next year if you would like to come and visit with us again. I want to thank your staff. They were extraordinarily helpful.

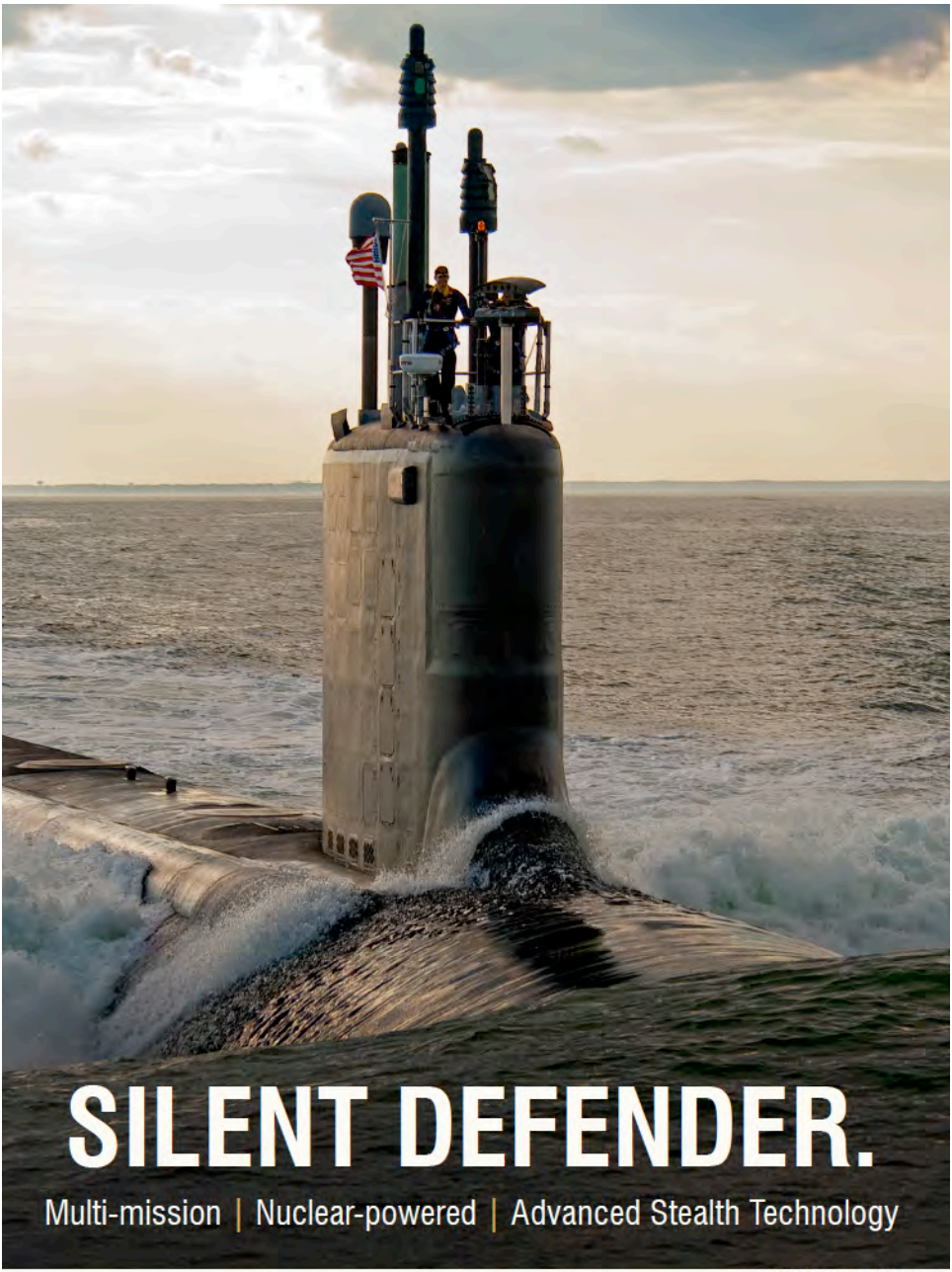
And I want to thank all our sponsors and guests, particularly our embassy guests and our military. Thank you, sir, again for your remarks and we look forward to seeing you next year.

ADM. HANEY: Thanks a lot.

ADM. HANEY: I forgot to mention one thing. I have this pamphlet up here and that is to invite you to our deterrence symposium that's going to be in Nebraska. So you can come out and have some Omaha steak or what have you there.

It's the 13th to the 14th of August, and you'll see that from our web site and what have you. But it's very important to have the right intellectual conversations there too.

MR. HUESSY: Thank you, sir.



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NAVY VIRGINIA (SSN-774) CLASS ATTACK SUBMARINE PROCUREMENT: BACKGROUND AND ISSUES FOR CONGRESS

RONALD O'ROURKE
SPECIALIST IN NAVAL AFFAIRS

JULY 31, 2014

CONGRESSIONAL RESEARCH SERVICE

Summary

The Navy has been procuring Virginia (SSN-774) class nuclear-powered attack submarines since FY1998. The two Virginia-class boats requested for procurement in FY2015 are to be the 21st and 22nd boats in the class. The 10 Virginia-class boats programmed for procurement in FY2014-FY2018 (two per year for five years) are being procured under a multiyear-procurement (MYP) contract.

The Navy estimates the combined procurement cost of the two Virginia-class boats requested for procurement in FY2015 at $5,288.7 million or an average of $2,644.3 million each. The boats have received a total of $1,577.0 million in prior-year advance procurement (AP) funding and $158.4 million in prior-year Economic Order Quantity (EOQ) funding. The Navy's proposed FY2015 budget requests the remaining $3,553.3 million needed to complete the boats' estimated combined procurement cost. The Navy's proposed FY2015 budget also requests $1,649.5 in AP funding and $680.8 million in EOQ funding for Virginia-class boats to be procured in future fiscal years, bringing the total FY2015 funding request for the program (excluding outfitting and post-delivery costs) to $5,883.6 million. EOQ funding is a common feature in the initial years of an MYP contract.

The Navy's proposed FY2015 budget also requests $132.6 million in research and development funding for the Virginia Payload Module (VPM). The funding is contained in Program Element (PE) 0604580N, entitled Virginia Payload Module (VPM), which is line 123 in the Navy's FY2015 research and development account.

DOD and the Navy are considering whether to build Virginia-class boats procured in FY2019 and subsequent years with an additional mid-body section, called the Virginia Payload Module (VPM), that contains four large-diameter, vertical launch tubes that the boats would use to store and fire additional Tomahawk cruise missiles or other payloads, such as large-diameter unmanned underwater vehicles (UUVs). The Navy estimates that building Virginia-class boats with the VPM might increase their unit procurement costs by about 13%. It would increase the total number of torpedo-sized weapons (such as Tomahawks) that they could carry by about 76%.

The Navy's FY2015 30-year SSN procurement plan, if implemented, would not be sufficient to maintain a force of 48 SSNs consistently over the long run. The Navy projects under that plan that the SSN force would fall below 48 boats starting in FY2025, reach a minimum of 41 boats in FY2028-FY2030, and remain below 48 boats through FY2034.

Potential issues for Congress regarding the Virginia-class program include the following:

- the Virginia-class procurement rate in coming years, particularly in the context of the SSN shortfall projected for FY2025-FY2034 and the larger debate over future U.S. defense strategy and defense spending; and
- Virginia-class program issues raised in a January 2014 report from DOD's Director, Operational Test and Evaluation (DOT&E).

The Navy's Ohio Replacement (SSBN[X]) ballistic missile submarine program is discussed in CRS Report R41129, Navy Ohio Replacement (SSBN[X]) Ballistic Missile Submarine Program.

Introduction

This report provides background information and issues for Congress on the Virginia-class nuclear-powered attack submarine (SSN) program. The Navy's proposed FY2015 budget requests $5,883.6 million in procurement, advance procurement (AP), and Economic Order Quantity (EOQ) funding for the program. Decisions that Congress makes on procurement of Virginia-class boats could substantially affect U.S. Navy capabilities and funding requirements, and the U.S. shipbuilding industrial base.

The Navy's Ohio Replacement (SSBN[X]) ballistic missile submarine program is discussed in another CRS report.[1]

Background

U.S. Navy Submarines[2]

The U.S. Navy operates three types of submarines—nuclear-powered ballistic missile submarines (SSBNs),[3] nuclear-powered cruise missile and special operations forces (SOF) submarines (SSGNs),[4] and nuclear-powered attack submarines (SSNs). The SSNs are general-purpose submarines that perform a variety of peacetime and wartime missions, including the following:

- covert intelligence, surveillance, and reconnaissance (ISR), much of it done for national-level (as opposed to purely Navy) purposes;
- covert insertion and recovery of SOF (on a smaller scale than possible with the SSGNs);
- covert strikes against land targets with the Tomahawk cruise missiles (again on a smaller scale than possible with the SSGNs);
- covert offensive and defensive mine warfare;
- anti-submarine warfare (ASW); and
- anti-surface ship warfare.

During the Cold War, ASW against the Soviet submarine force was the primary stated mission of U.S. SSNs, although covert ISR and covert SOF insertion/recovery operations were reportedly important on a day-to-day basis as well.[5] In the post-Cold War era, although anti-submarine warfare remains a mission,

the SSN force has focused more on performing the other missions noted on the list above.

Attack Submarine Force Levels

Force-Level Goal

The Navy wants to achieve and maintain a fleet in coming years of 306 ships, including 48 SSNs.[6] For a review of SSN force level goals since the Reagan Administration, see *Appendix A*.

Force Level at End of FY2013

The SSN force included more than 90 boats during most of the 1980s, when plans called for achieving a 600-ship Navy including 100 SSNs. The number of SSNs peaked at 98 boats at the end of FY1987 and has declined since then in a manner that has roughly paralleled the decline in the total size of the Navy over the same time period. The 54 SSNs in service at the end of FY2013 included the following:

- 41 Los Angeles (SSN-688) class boats;
- 3 Seawolf (SSN-21) class boats; and
- 10 Virginia (SSN-774) class boats.

Los Angeles- and Seawolf-Class Boats

A total of 62 Los Angeles-class submarines, commonly called 688s, were procured between FY1970 and FY1990 and entered service between 1976 and 1996. They are equipped with four 21-inch diameter torpedo tubes and can carry a total of 26 torpedoes or Tomahawk cruise missiles in their torpedo tubes and internal magazines. The final 31 boats in the class (SSN-719 and higher) are equipped with an additional 12 vertical launch system (VLS) tubes in their bows for carrying and launching another 12 Tomahawk cruise missiles. The final 23 boats in the class (SSN-751 and higher) incorporate further improvements and are referred to as Improved Los Angeles class boats or 688Is. As of the end of FY2013, 21 of the 62 boats in the class had been retired.

The Seawolf class was originally intended to include about 30 boats, but Seawolf-class procurement was stopped after three boats as a result of the end of the Cold War and associated changes in military requirements. The three Seawolf-class submarines are the Seawolf (SSN-21), the Connecticut (SSN-22), and the Jimmy Carter (SSN-23). SSN-21 and SSN-22 were procured in FY1989 and FY1991 and entered service in 1997 and 1998, respectively. SSN-23 was originally procured in FY1992. Its procurement was suspended in 1992 and then reinstated in FY1996. It entered service in 2005. Seawolf-class submarines are larger than Los Angeles-class boats or previous U.S. Navy SSNs.[7] They are equipped with eight 30-inch-diameter torpedo tubes and can carry a total of 50 torpedoes or cruise missiles. SSN-23 was built to a lengthened configuration compared to the other two ships in the class.[8]

Virginia (SSN-774) Class Program

General

The Virginia-class attack submarine was designed to be less expensive and better optimized for post-Cold War submarine missions than the Seawolf-class design. The Virginia class design is slightly larger than the Los Angeles-class design,[9] but incorporates newer technologies. Virginia-class boats currently cost about $2.8 billion each to procure. The first Virginia-class boat entered service in October 2004.

Past and Projected Annual Procurement Quantities

Table 1 shows annual numbers of Virginia-class boats procured from FY1998 (the lead boat) through FY2014, and numbers scheduled for procurement under the FY2015-FY2019 Future Years Defense Plan (FYDP).

Table 1. Annual Numbers of Virginia-Class Boats Procured

FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08
1	1	0	1	1	1	1	1	1	1	1
FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19
1	1	2	2	2	2	2	2	2	2	2

Multiyear Procurement (MYP)

The 10 Virginia-class boats shown in Table 1 for the period FY2014-FY2018 (referred to as the Block IV boats) are being procured under a multiyear procurement (MYP) contract[10] that was approved by Congress as part of its action on the FY2013 budget, and awarded by the Navy on April 28, 2014. The eight Virginia-class boats procured in FY2009-FY2013 (the Block III boats) were procured under a previous MYP contract, and the five Virginia-class boats procured in FY2004-FY2008 (the Block II boats) were procured under a still-earlier MYP contract. The four boats procured in FY1998-FY2002 (the Block I boats) were procured under a block buy contract, which is an arrangement somewhat similar to an MYP contract.[11] The boat procured in FY2003 fell between the FY1998-FY2002 block buy contract and the FY2004-FY2008 MYP arrangement, and was contracted for separately.

Joint Production Arrangement

Virginia-class boats are built jointly by General Dynamics' Electric Boat Division (GD/EB) of Groton, CT, and Quonset Point, RI, and Newport News Shipbuilding (NNS), of Newport News, VA, which forms part of Huntington Ingalls Industries (HII).[12] Under the arrangement, GD/EB builds certain parts of each boat, NNS builds certain other parts of each boat, and the yards take turns building the reactor compartments and performing final assembly of the boats. GD/EB is building the reactor compartments and performing final assembly on boats 1, 3, and so on, while NNS is doing so on boats 2, 4, and so on. The arrangement results in a roughly 50-50 division of Virginia-class profits between the two yards and preserves both yards' ability to build submarine reactor compartments (a key capability for a submarine-construction yard) and perform submarine final-assembly work.[13]

Cost-Reduction Effort

The Navy states that it achieved a goal of reducing the procurement cost of Virginia-class submarines so that two boats could be procured in FY2012 for combined cost of $4.0 billion in constant FY2005 dollars—a goal referred to as "2 for 4 in 12." Achieving this goal involved removing about $400 million (in constant FY2005 dollars) from the cost of each submarine. (The Navy calculates that the unit target cost of $2.0 billion in constant FY2005 dollars for each submarine translates into about $2.6 billion for a boat procured in FY2012.)[14]

Virginia Payload Module (VPM)

DOD and the Navy are considering building Virginia-class boats procured in FY2019 and subsequent years (i.e., the anticipated Block V and beyond boats) with an additional mid-body section, called the Virginia Payload Module (VPM). The VPM, reportedly about 70 feet in length[15] (earlier design concepts for the VPM were reportedly about 94 feet in length),[16] contains four large-diameter, vertical launch tubes that would be used to store and fire additional Tomahawk cruise missiles or other payloads, such as large-diameter unmanned underwater vehicles (UUVs).[17]

The four additional launch tubes in the VPM could carry a total of 28 additional Tomahawk cruise missiles (7 per tube),[18] which would increase the total number of torpedo-sized weapons (such as Tomahawks) carried by the Virginia class design from about 37 to about 65—an increase of about 76%.[19]

Building Virginia-class boats with the VPM would compensate for a sharp loss in submarine force weapon-carrying capacity that will occur with the retirement in FY2026-FY2028 of the Navy's four Ohio-class cruise missile/special operations forces support submarines (SSGNs).[20] Each SSGN is equipped with 24 large-diameter vertical launch tubes, of which 22 can be used to carry up to 7 Tomahawks each, for a maximum of 154 vertically launched Tomahawks per boat, or 616 vertically launched

Tomahawks for the four boats. Twenty-two Virginia-class boats built with VPMs could carry 616 Tomahawks in their VPMs. The Navy estimates that adding the VPM would increase the procurement cost of the Virginia class design by $350 million in current dollars, or by about 13%.[21]

FY2015 Funding Request

The Navy estimates the combined procurement cost of the two Virginia-class boats requested for procurement in FY2015 at $5,288.7 million or an average of $2,644.3 million each. The boats have received a total of $1,577.0 million in prior-year advance procurement (AP) funding and $158.4 million in prior-year Economic Order Quantity (EOQ) funding. The Navy's proposed FY2015 budget requests the remaining $3,553.3 million needed to complete the boats' estimated combined procurement cost. The Navy's proposed FY2015 budget also requests $1,649.5 million in AP funding and $680.8 million in EOQ funding for Virginia-class boats to be procured in future fiscal years, bringing the total FY2015 funding request for the program (excluding outfitting and post-delivery costs) to $5,883.6 million. EOQ funding is a common feature in the initial years of an MYP contract.

The Navy's proposed FY2015 budget also requests $132.6 million in research and development funding for the Virginia Payload Module (VPM). The funding is contained in Program Element (PE) 0604580N, entitled Virginia Payload Module (VPM), which is line 123 in the Navy's FY2015 research and development account.

Submarine Construction Industrial Base

In addition to GD/EB and NNS, the submarine construction industrial base includes scores of supplier firms, as well as laboratories and research facilities, in numerous states. Much of the total material procured from supplier firms for the construction

of submarines comes from single or sole source suppliers. Observers in recent years have expressed concern for the continued survival of many of these firms. For nuclear-propulsion component suppliers, an additional source of stabilizing work is the Navy's nuclear-powered aircraft carrier construction program.[22] In terms of work provided to these firms, a carrier nuclear propulsion plant is roughly equivalent to five submarine propulsion plants.

Much of the design and engineering portion of the submarine construction industrial base is resident at GD/EB. Smaller portions are resident at NNS and some of the component makers.

Several years ago, some observers expressed concern about the Navy's plans for sustaining the design and engineering portion of the submarine construction industrial base. These concerns appear to have receded, in large part because of the Navy's plan to design and procure a next generation ballistic missile submarine called the Ohio Replacement Program or SSBN(X).[23]

Projected SSN Shortfall

Size and Timing of Shortfall

The Navy's FY2015 30-year SSN procurement plan, if implemented, would not be sufficient to maintain a force of 48 SSNs consistently over the long run. As shown in Table 2, the Navy projects under the plan that the SSN force would fall below 48 boats starting in FY2025, reach a minimum of 41 boats in FY2028-FY2030, and remain below 48 boats through 2034. Since the Navy plans to retire the four SSGNs by 2028 without procuring any replacements for them, no SSGNs would be available in 2028 and subsequent years to help compensate for a drop in SSN force level below 48 boats.

The projected SSN shortfall has been discussed in CRS reports and testimony since 1995.

Table 2. Projected SSN Shortfall

As shown in Navy's FY2015 30-Year (FY2015-FY2044) Shipbuilding Plan

Fiscal year	Annual Procurement Quantity	Projected number of SSNs	Shortfall relative to 48-boat goal	
			Number of ships	Percent
15	2	54		
16	2	53		
17	2	50		
18	2	52		
19	2	51		
20	2	49		
21	1	49		
22	2	48		
23	1	49		
24	2	48		
25	1	47	-1	-2%
26	2	45	-3	-6%
27	1	44	-4	-8%
28	2	41	-7	-15%
29	1	41	-7	-15%
30	2	41	-7	-15%
31	1	43	-5	-10%
32	2	43	-5	-10%
33	1	45	-3	-6%
34	2	46	-2	-4%
35	1	48		
36	2	49		
37	1	51		
38	2	50		
39	1	51		
40	2	51		
41	1	51		
42	2	52		
43	1	52		
44	2	52		

Source: Table prepared by CRS based on Navy's FY2015 30-year shipbuilding plan. Percent figures rounded to nearest percent.

2006 Navy Study on Options for Mitigating Projected Shortfall

The Navy in 2006 initiated a study on options for mitigating the projected SSN shortfall. The study was completed in early

2007 and briefed to CRS and the Congressional Budget Office (CBO) on May 22, 2007.[24] At the time of the study, the SSN force was projected to bottom out at 40 boats and then recover to 48 boats by the early 2030s. Principal points in the Navy study (which cite SSN force-level projections as understood at that time) include the following:

- The day-to-day requirement for deployed SSNs is 10.0, meaning that, on average, a total of 10 SSNs are to be deployed on a day-to-day basis.[25]
- The peak projected wartime demand is about 35 SSNs deployed within a certain amount of time. This figure includes both the 10.0 SSNs that are to be deployed on a day-to-day basis and 25 additional SSNs surged from the United States within a certain amount of time.[26]
- Reducing Virginia-class shipyard construction time to 60 months—something that the Navy already plans to do as part of its strategy for meeting the Virginia class cost-reduction goal (see earlier discussion on cost-reduction goal)—will increase the size of the SSN force by two boats, so that the force would bottom out at 42 boats rather than 40.[27]
- If, in addition to reducing Virginia-class shipyard construction time to 60 months, the Navy also lengthens the service lives of 16 existing SSNs by periods ranging from 3 months to 24 months (with many falling in the range of 9 to 15 months), this would increase the size of the SSN force by another two boats, so that the force would bottom out at 44 boats rather than 40 boats.[28] The total cost of extending the lives of the 16 boats would be roughly $500 million in constant FY2005 dollars.[29]
- The resulting force that bottoms out at 44 boats could meet the 10.0 requirement for day-to-day deployed SSNs throughout the 2020-2033 period if, as an additional option, about 40 SSN deployments occurring in the eight-year period 2025-2032 were lengthened from six months to seven months. These 40 or so lengthened deployments would represent about one-quarter of all the SSN deployments that

would take place during the eight-year period.

- The resulting force that bottoms out at 44 boats could not meet the peak projected wartime demand of about 35 SSNs deployed within a certain amount of time. The force could generate a total deployment of 32 SSNs within the time in question—3 boats (or about 8.6%) less than the 35-boat figure. Lengthening SSN deployments from six months to seven months would not improve the force's ability to meet the peak projected wartime demand of about 35 SSNs deployed within a certain amount of time.
- To meet the 35-boat figure, an additional four SSNs beyond those planned by the Navy would need to be procured. Procuring four additional SSNs would permit the resulting 48-boat force to surge an additional three SSNs within the time in question, so that the force could meet the peak projected wartime demand of about 35 SSNs deployed within a certain amount of time.
- Procuring one to four additional SSNs could also reduce the number of seven-month deployments that would be required to meet the 10.0 requirement for day-to-day deployed SSNs during the period 2025-2032. Procuring one additional SSN would reduce the number of seven-month deployments during this period to about 29; procuring two additional SSNs would reduce it to about 17, procuring three additional SSNs would reduce it to about 7, and procuring four additional SSNs would reduce it to 2.

The Navy added a number of caveats to these results, including but not limited to the following:

- The requirement for 10.0 SSNs deployed on a day-to-day basis is a current requirement that could change in the future.
- The peak projected wartime demand of about 35 SSNs deployed within a certain amount of time is an internal Navy figure that reflects recent analyses of potential future wartime requirements for SSNs. Subsequent analyses of this

issue could result in a different figure.

- The identification of 19 SSNs as candidates for service life extension reflects current evaluations of the material condition of these boats and projected use rates for their nuclear fuel cores. If the material condition of these boats years from now turns out to be worse than the Navy currently projects, some of them might no longer be suitable for service life extension. In addition, if world conditions over the next several years require these submarines to use up their nuclear fuel cores more quickly than the Navy now projects, then the amounts of time that their service lives might be extended could be reduced partially, to zero, or to less than zero (i.e., the service lives of the boats, rather than being extended, might need to be shortened).
- The analysis does not take into account potential rare events, such as accidents, that might force the removal of an SSN from service before the end of its expected service life.[30]
- Seven-month deployments might affect retention rates for submarine personnel.

Issues for Congress

Virginia-Class Procurement Rate More Generally in Coming Years

One potential issue for Congress concerns the Virginia-class procurement rate in coming years, particularly in the context of the SSN shortfall projected for FY2025-FY2034 shown in Table 2 and the larger debate over future U.S. defense strategy and defense spending.

Mitigating Projected SSN Shortfall

In addition to lengthening SSN deployments to 7 months and extending the service lives of existing SSNs by periods ranging from 3 months to 24 months (see “2006 Navy Study on Options for Mitigating Projected Shortfall” above), options for more fully

mitigating the projected SSN shortfall include:

- refueling a small number of (perhaps one to five) existing SSNs and extending their service lives by 10 years or more, and
- putting additional Virginia-class boats into the 30-year shipbuilding plan.

It is not clear whether it would be feasible or cost-effective to refuel existing SSNs and extend their service lives by 10 or more years, given factors such as limits on submarine pressure hull life.

Larger Debate on Defense Strategy and Defense Spending

Some observers—particularly those who propose reducing U.S. defense spending as part of an effort to reduce the federal budget deficit—have recommended that the SSN force-level goal be reduced to something less than 48 boats, and/or that Virginia-class procurement be reduced. A June 2010 report from a group called the Sustainable Defense Task Force recommends a Navy of 230 ships, including 37 SSNs,[31] and a September 2010 report from the Cato Institute recommends a Navy of 241 ships, including 40 SSNs.[32] Both reports recommend limiting Virginia-class procurement to one boat per year, as does a September 2010 report from the Center for American Progress.[33] A November 2010 report from a group called the Debt Reduction Task Force recommends "deferring" Virginia-class procurement.[34] The November 2010 draft recommendations of the co-chairs of the Fiscal Commission include recommendations for reducing procurement of certain weapon systems; the Virginia-class program is not among them.

Other observers have recommended that the SSN force-level goal should be increased to something higher than 48 boats, particularly in light of Chinese naval modernization.[35] The July 2010 report of an independent panel that assessed the 2010 Quadrennial Defense Review (QDR)—an assessment that is required by the law governing QDRs (10 U.S.C. 118)—recommends a Navy of 346 ships, including 55 SSNs.[36] An April 2010 report from the Heritage Foundation recommends a Navy of

309 ships, including 55 SSNs.[37]

Factors to consider in assessing whether to maintain, increase, or reduce the SSN force-level goal and/or planned Virginia-class procurement include but are not limited to the federal budget and debt situation, the value of SSNs in defending U.S. interests and implementing U.S. national security strategy, and potential effects on the submarine industrial base.

As discussed earlier, Virginia-class boats scheduled for procurement in FY2014 are covered under an MYP contract for the period FY2014-FY2018. This MYP contract includes the procurement of two Virginia-class boats in FY2015. If fewer than two boats were procured in FY2015, the Navy might need to terminate the MYP contract and pay a cancellation penalty to the contractor.

Program Issues Raised in January 2014 DOT&E Report

Another oversight issue for Congress concerns Virginia-class program issues raised in a January 2014 report from the DOD's Director, Operational Test and Evaluation (DOT&E)—DOT&E's annual report for FY2013. Regarding the Virginia-class program, the report stated:

Assessment

- The October 2013 DOT&E classified report details Virginia's ability to host NSW [Naval Special Warfare] missions from a DDS [Dry Deck Shelter] and concluded the following:
- Virginia class submarines are capable of hosting the DDS system.
- Virginia class submarines can remain covert during NSW missions in some environments against some threat forces. Testing was not sufficient to fully evaluate the covertness of the class during DDS operations against expected threats. DOT&E's report provided estimates for probability to remain covert based on the data available. Furthermore, the Navy's primary metric for assessing success in these missions is a binary probability, which is infeasible to measure.

- Operational testing was adequate for an assessment of the Virginia class submarine's effectiveness and suitability for NSW missions using a DDS only against a low-end threat.
- The Navy's Commander, Operational Test and Evaluation Force (COTF) did not conduct test execution in accordance with the DOT&E-approved test plan. Specifically, COTF failed to collect positional data from the assigned simulated opposing forces, which limited the ability to assess covertness during these operations. Additionally, the testing did not provide data to address acoustic vulnerabilities during NSW operations using a DDS.

- The Virginia class submarine is suitable for NSW operations using a DDS; however, the Navy identified shortcomings in the Virginia class in testing.

- Space limitations onboard the submarines restrict movement to and from the control room, which potentially impedes the ship's ability to execute damage control procedures in the event a casualty occurs during NSW operations using a DDS.
- During conditions of low visibility, including nighttime operations, Special Operations Force (SOF) members on the surface may have difficulty seeing the photonics mast of a submerged submarine, which is used to guide the movement of the SOF as they return to the submarine.
- The Navy made modifications to the SEAL Delivery Vehicle (SDV) Auxiliary Life Support System (ALSS) used in some DDS operations. These modifications allow for increased air pressure and as a result, more available man-hours to support missions. The Virginia class air supply system to pressurize the ALSS does not support operating at the higher pressures.
- The May 2013 DOT&E report on Virginia's operational capabilities in the Arctic and the Virginia's susceptibility to low-frequency passive acoustic detection concluded that:
- Testing was adequate for an assessment of effectiveness and suitability to support general Arctic operations and of the susceptibility of the submarine to detection by passive

acoustic sensors. The Navy conducted the testing in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plan but data were not available to conduct the desired quantitative assessment because the Navy did not retain the data following the testing.

- Virginia class submarines are effective at supporting general operations in the Arctic but remain ineffective at ASW against some targets, which is unchanged from previous testing reported on by DOT&E. During testing, the Virginia class submarine was hampered with a failure of its sonar system's TB-29 towed array. The failure of the towed-array affected the submarine's performance because it provided the longest-range detections of acoustic contacts. However, these arrays are known to be fragile and do frequently fail during operations.
- As part of the operational testing, an evaluation of the Depth-Encoded Ice-Keel Avoidance (IKA) mode of the Acoustic Rapid Commercial Off-the-Shelf Insertion (A-RCI) sonar system was included. Ice-keels extend down from the ice canopy above the submarine when operating in regions of the Arctic covered by ice. This Depth-Encoded IKA mode uses active sonar with the intention of providing operators with location, size, and depth of ice-keels so that the submarine can avoid colliding with them. The testing showed that the Depth-Encoded IKA is fundamentally limited by the precision to which a submarine can know the propagation path of the active sonar and as a result, the Depth-Encoded IKA is unable to achieve the threshold for accuracy established by the Navy.
- Virginia class submarines are difficult to detect with low-frequency passive acoustic sensors. Like all other classes of U.S. submarines, when operating at high speeds Virginia class submarines become more susceptible to detection by passive acoustic sensors.
- Virginia class submarines provide less Arctic capability than the Seawolf and improved Los Angeles class submarines. Some regions of the Arctic are characterized by tight

vertical clearances between the shallow ocean floor below and the thick ice canopy above. Virginia lacks a hardened sail, and is therefore limited in the thickness of ice through which the submarine can safely surface.

- The Virginia class submarine is operationally suitable for supporting general Arctic operations but suffers from some reliability shortcomings:
- The IKA modes of the A-RCI sonar system reliability require improvement to support extended periods of challenging under-ice operations. After a decade of development and fielding, no hardware or software variant of A-RCI has come close to the Navy's reliability requirement, which is based on an operational need. More reliable sonar processing hardware is typically brought onboard because of the poor A-RCI reliability.
- The common methods of removing carbon dioxide and hydrogen waste gas consistently failed during operations in the cold Arctic environment.

  - The handling system for the Virginia class submarine's Buoyant Cable Antenna, used for communications during operations under the ice canopy, is susceptible to freezing, preventing subsequent deployment or retrieval.

  - The Virginia class submarine suffers from excessive condensation in the cold Arctic environment. In general, this is an insulation problem since water vapor will condense on any surface with a temperature below the local dew point. Excessive condensation has the potential to cause problems with electronic systems.

- DOT&E's classified report on Virginia's modernization FOT&E, issued in November 2012, concluded the following:
- Virginia's operational effectiveness is dependent on the mission conducted. The modernization of the sonar and fire control systems (A-RCI and AN/BYG-1) with the APB 09 software did not change (improve or degrade) the performance of the Virginia class for the missions tested. DOT&E's assessment of mission effectiveness remains the

same for ASW; Intelligence, Surveillance, and Reconnaissance; High-Density Contact Management; situational awareness; and Mine Avoidance. DOT&E's overall assessment of Information Assurance remains unchanged from IOT&E, although the new software represents an improvement in Information Assurance over previous systems.

- Although Virginia was not effective for some of the missions tested, it remains an effective replacement for the Los Angeles class submarine, providing similar mission performance and improved covertness.
- Testing to examine ASW-attack and situational awareness in high-density environments was adequate for the system software that was tested but not adequate for the software version that the Navy fielded. After completion of operational testing, the Navy issued software changes intended to address the severe performance problems observed with the Wide Aperture Array. The Navy has not completed operational testing on the new software, which is fielded on deployed submarines. DOT&E assesses that the late fix of the array's deficiencies is a result of the Navy's schedule-driven development processes, which fields new increments without completing adequate developmental testing.
- The Navy collected adequate data to assess the suitability of the sonar and fire control systems. Insufficient data were collected to reassess the suitability of Virginia's hull, mechanical, electrical, or electronic systems; however, these data were not expected to demonstrate significantly different reliability compared to what was observed in IOT&E. Of note, the installation of the new APB 09 on Virginia's A-RCI sonar system will degrade the reliability of the sonar system on these submarines relative to what was demonstrated in the IOT&E.

Recommendations

• Status of Previous Recommendations.

- The Navy has made progress in addressing 23 of the 30

recommendations contained in the November 2009 classified FOT&E report. Of the seven outstanding recommendations, the significant unclassified recommendations are:
1. Test against a diesel submarine threat surrogate in order to evaluate Virginia's capability, detectability, and survivability against modern diesel-electric submarines.
2. Conduct an FOT&E to examine Virginia's susceptibility to airborne ASW threats such as Maritime Patrol Aircraft and helicopters.
- The following recommendations from the FY12 Annual Report remain open and the Navy should work to address them in the upcoming fiscal year:
3. Coordinate the Virginia, A-RCI, and AN/BYG-1 Test and Evaluation Master Plans and utilize Undersea Enterprise Capstone documents to facilitate testing efficiencies.
4. Complete the verification, validation, and accreditation of the TSA method used for Virginia class Block III items.
5. Repeat the FOT&E event to determine Virginia's susceptibility to low-frequency active sonar and the submarine's ability to conduct Anti-Surface Warfare in a low-frequency active environment. This testing should include a Los Angeles class submarine operating in the same environment to enable comparison with the Virginia class.

• FY13 Recommendations. The Virginia DDS and Arctic reports generated 16 recommendations. The following are unclassified recommendations listed in the October 2013 FOT&E report. The Navy should:

1. Reconsider the metrics used to assess Virginia class submarine's ability to covertly conduct mass swimmer lockout operations using the DDS.
2. Evaluate the possible acoustic vulnerabilities associated with SDV employment.
3. Seek additional evaluations of Virginia class operations with a DDS to improve understanding of deployment time for operations and operationally evaluate covertness.

4. Confirm that the access to and from the Control Room during DDS operations meet the requirements of the Submarine Safety Program for accessibility and are sufficient to provide for adequate damage control in the event of casualties.
5. The Navy should investigate and implement methods to aid the SOF in identifying the submarine during operations in conditions of low visibility.
6. Investigate modifying the reducer in the air charging system to allow higher air pressure for the SDV Auxiliary Life Support System in order to provide increased flexibility for SDV missions that can be hosted from Virginia class submarines.
7. Re-evaluate the accuracy requirements for the IKA sonar modes and investigate the calibration of those modes.
8. Continue the reliability improvement program for the TB-29 towed-array or pursue the development of a new array.
9. Improve the reliability of the A-RCI IKA sonar modes.
10. Modify atmosphere control subsystems to operate properly in the freezing waters of the Arctic Ocean.
11. Modify the handling system of the Buoyant Antenna Cable to prevent its freezing in the cold Arctic environment.
12. Continue to collect data on the susceptibility of the Virginia class to low-frequency passive systems and conduct a more quantitative assessment (e.g., determine detection ranges for different ship postures).[38]

Delay in Commissioning of North Dakota (SSN-784)

Another oversight issue for Congress concerns a delay in the commissioning of the North Dakota (SSN-784), the first Block III Virginia-class boat, which the Navy announced on April 16, 2014. In announcing the delay, the Navy stated that This decision is based on the need for additional design and certification work required on the submarine's redesigned bow and material issues with vendor-assembled and delivered components. As the Navy works with all vested parties to certify the quality and safety of the submarine and toward taking delivery of the boat, it will determine a new commissioning date.

The Navy is committed to ensuring the safety of its crews and ships. High quality standards for submarine components are an important part of the overall effort to ensure safety.
The lessons learned from North Dakota are already being applied to all Block III submarines.[39]

Legislative Activity for FY2015

FY2015 Funding Request

The Navy estimates the combined procurement cost of the two Virginia-class boats requested for procurement in FY2015 at $5,288.7 million or an average of $2,644.3 million each. The boats have received a total of $1,577.0 million in prior-year advance procurement (AP) funding and $158.4 million in prior-year Economic Order Quantity (EOQ) funding. The Navy's proposed FY2015 budget requests the remaining $3,553.3 million needed to complete the boats' estimated combined procurement cost. The Navy's proposed FY2015 budget also requests $1,649.5 in AP funding and $680.8 million in EOQ funding for Virginia-class boats to be procured in future fiscal years, bringing the total FY2015 procurement funding request for the program (excluding outfitting and post-delivery costs) to $5,883.6 million. (EOQ funding is a common feature in the initial years of an MYP contract.)

The Navy's proposed FY2015 budget also requests $132.6 million in research and development funding for the Virginia Payload Module (VPM). The funding is contained in Program Element (PE) 0604580N, entitled Virginia Payload Module (VPM), which is line 123 in the Navy's FY2015 research and development account.

FY2015 National Defense Authorization Act (H.R. 4435/S. 2410) House

The House Armed Services Committee, in its report (H.Rept. 113-446 of May 13, 2014) on H.R. 4435, recommends approving the Navy's request for FY2015 procurement and advance

procurement (AP) funding for the Virginia-class program (page 395, line 002 and 003), and the Navy's request for FY2015 research and development funding for the Virginia Payload Module (VPM) (page 429, line 123). H.Rept. 113-446 states:

Virginia Payload Module program

The budget request contained $132.6 million in PE 64580N for development of the Virginia Payload Module (VPM) program. The committee believes that undersea strike capability will be a critical capability for the U.S. military in the future, as U.S. forces begin to operate in increasingly contested environments. In addition, the committee notes that with the pending retirement of the four guided-missile nuclear submarines (SSGN), the U.S. military will lose a significant portion of its undersea strike capability. The committee believes that the VPM program is the lowest risk, lowest cost, and best path for maintaining, and eventually expanding, critical undersea strike capabilities. The committee also notes that by integrating the new strike capability into Block V Virginia-class submarines, the Navy is avoiding having to start an entirely new program that could take decades to come to fruition, whereas in contrast, the VPM program could provide this new capability to the fleet in time to partially compensate for the retirement of the SSGNs. Therefore the committee continues to support the VPM program.

The committee recommends $132.6 million, the full amount requested, in PE 64580N for development of the VPM program. (Page 67)

Senate

The Senate Armed Services Committee, in its report (S.Rept. 113-176 of June 2, 2014) on S. 2410, recommends approving the Navy's request for FY2015 procurement and advance procurement (AP) funding for the Virginia-class program (page 323, line 002 and 003), and the Navy's request for FY2015 research and development funding for the Virginia Payload Module (VPM) (page 359, line 123).

FY2015 DOD Appropriations Act (H.R. 4870)
House

The House Appropriations Committee, in its report (H.Rept. 113-473 of June 13, 2014) on H.R.4870, recommends

• reducing by $46.079 million the Navy's request for FY2015 procurement funding for the Virginia-class program, with the reduction being for "Propulsion equipment cost growth" ($42.7 million) and "GFE [government-furnished equipment] savings" ($3.379 million) (page 163, line 2, and page 164, line 2);

• reducing by $28.5 million the Navy's request for FY2015 advance procurement (AP) funding for the Virginia-class program, with the reduction being for "Propulsion equipment cost growth" (page 163, line 3, and page 164, line 3); and

• approving the Navy's request for FY2015 research and development funding for the Virginia Payload Module (VPM) (page 231, line 123).

Senate

The Senate Appropriations Committee, in its report (S.Rept. 113-211 of July 17, 2014) on H.R. 4870, recommends approving the Navy's request for FY2015 procurement and advance procurement (AP) funding for the Virginia-class program (page 138, lines 2 and 3), and reducing by $20 million the Navy's request for FY2015 research and development funding for the Virginia Payload Module (VPM) (page 203, line 123), with the reduction being for "Restoring acquisition accountability: Program execution" (page 208, line 123).

Appendix A. Past SSN Force-Level Goals

This appendix summarizes attack submarine force-level goals since the Reagan Administration (1981-1989).

The Reagan-era plan for a 600-ship Navy included an objective of achieving and maintaining a force of 100 SSNs.

The George H. W. Bush Administration's proposed Base Force plan of 1991-1992 originally called for a Navy of more than

400 ships, including 80 SSNs.[40] In 1992, however, the SSN goal was reduced to about 55 boats as a result of a 1992 Joint Staff force-level requirement study (updated in 1993) that called for a force of 51 to 67 SSNs, including 10 to 12 with Seawolf-level acoustic quieting, by the year 2012.[41]

The Clinton Administration, as part of its 1993 Bottom-Up Review (BUR) of U.S. defense policy, established a goal of maintaining a Navy of about 346 ships, including 45 to 55 SSNs.[42] The Clinton Administration's 1997 QDR supported a requirement for a Navy of about 305 ships and established a tentative SSN force-level goal of 50 boats, "contingent on a reevaluation of peacetime operational requirements."[43] The Clinton Administration later amended the SSN figure to 55 boats (and therefore a total of about 310 ships).

The reevaluation called for in the 1997 QDR was carried out as part of a Joint Chiefs of Staff (JCS) study on future requirements for SSNs that was completed in December 1999. The study had three main conclusions:

• "that a force structure below 55 SSNs in the 2015 [time frame] and 62 [SSNs] in the 2025 time frame would leave the CINC's [the regional military commanders-in-chief] with insufficient capability to respond to urgent crucial demands without gapping other requirements of higher national interest. Additionally, this force structure [55 SSNs in 2015 and 62 in 2025] would be sufficient to meet the modeled war fighting requirements";

• "that to counter the technologically pacing threat would require 18 Virginia class SSNs in the 2015 time frame"; and

• "that 68 SSNs in the 2015 [time frame] and 76 [SSNs] in the 2025 time frame would meet all of the CINCs' and national intelligence community's highest operational and collection requirements."[44]

The conclusions of the 1999 JCS study were mentioned in discussions of required SSN force levels, but the figures of 68 and 76 submarines were not translated into official Department of Defense (DOD) force-level goals.

The George W. Bush Administration's report on the 2001 QDR revalidated the amended requirement from the 1997 QDR

for a fleet of about 310 ships, including 55 SSNs. In revalidating this and other U.S. military force-structure goals, the report cautioned that as DOD's "transformation effort matures—and as it produces significantly higher output of military value from each element of the force—DOD will explore additional opportunities to restructure and reorganize the Armed Forces."[45]

DOD and the Navy conducted studies on undersea warfare requirements in 2003-2004. One of the Navy studies—an internal Navy study done in 2004—reportedly recommended reducing the attack submarine force level requirement to as few as 37 boats. The study reportedly recommended homeporting a total of nine attack submarines at Guam and using satellites and unmanned underwater vehicles (UUVs) to perform ISR missions now performed by attack submarines.[46]

In March 2005, the Navy submitted to Congress a report projecting Navy force levels out to FY2035. The report presented two alternatives for FY2035—a 260-ship fleet including 37 SSNs and 4 SSGNs, and a 325-ship fleet including 41 SSNs and 4 SSGNs.[47]

In May 2005, it was reported that a newly completed DOD study on attack submarine requirements called for maintaining a force of 45 to 50 boats.[48]

In February 2006, the Navy proposed to maintain in coming years a fleet of 313 ships, including 48 SSNs. Some of the Navy's ship force-level goals have changed since 2006, and the goals now add up to a desired fleet of 328 ships. The figure of 48 SSNs, however, remains unchanged from 2006.

Appendix B. Options for Funding SSNs

This appendix presents information on some alternatives for funding SSNs that was originally incorporated into this report during discussions in earlier years on potential options for Virginia class procurement.

Alternative methods of funding the procurement of SSNs include but are not necessarily limited to the following:

- **two years of advance procurement funding followed by full funding**—the traditional approach, under which there

are two years of advance procurement funding for the SSN's long-lead time components, followed by the remainder of the boat's procurement funding in the year of procurement;

- **one year of advance procurement funding followed by full funding**—one year of advance procurement funding for the SSN's long-lead time components, followed by the remainder of the boat's procurement funding in the year of procurement;
- **full funding with no advance procurement funding (single-year full funding)**—full funding of the SSN in the year of procurement, with no advance procurement funding in prior years;
- **incremental funding**—partial funding of the SSN in the year of procurement, followed by one or more years of additional funding increments needed to complete the procurement cost of the ship; and
- **advance appropriations**—a form of full funding that can be viewed as a legislatively locked in form of incremental funding.[49]

Navy testimony to Congress in early 2007, when Congress was considering the FY2008 budget, suggested that two years of advance procurement funding are required to fund the procurement of an SSN, and consequently that additional SSNs could not be procured until FY2010 at the earliest.[50] This testimony understated Congress's options regarding the procurement of additional SSNs in the near term. Although SSNs are normally procured with two years of advance procurement funding (which is used primarily for financing long-leadtime nuclear propulsion components), Congress can procure an SSN without prior-year advance procurement funding, or with only one year of advance procurement funding. Consequently, Congress at that time had option of procuring an additional SSN in FY2009 and/or FY2010.

Single-year full funding has been used in the past by Congress to procure nuclear-powered ships for which no prior-year advance procurement funding had been provided. Specifically, Congress

used single-year full funding in FY1980 to procure the nuclear-powered aircraft carrier CVN-71, and again in FY1988 to procure the CVNs 74 and 75. In the case of the FY1988 procurement, under the Administration's proposed FY1988 budget, CVNs 74 and 75 were to be procured in FY1990 and FY1993, respectively, and the FY1988 budget was to make the initial advance procurement payment for CVN-74. Congress, in acting on the FY1988 budget, decided to accelerate the procurement of both ships to FY1988, and fully funded the two ships that year at a combined cost of $6.325 billion. The ships entered service in 1995 and 1998, respectively.[51]

The existence in both FY1980 and FY1988 of a spare set of Nimitz-class reactor components was not what made it possible for Congress to fund CVNs 71, 74, and 75 with single-year full funding; it simply permitted the ships to be built more quickly. What made it possible for Congress to fund the carriers with single-year full funding was Congress's constitutional authority to appropriate funding for that purpose.

Procuring an SSN with one year of advance procurement funding or no advance procurement funding would not materially change the way the SSN would be built—the process would still encompass about two years of advance work on long-leadtime components, and an additional six years or so of construction work on the ship itself. The outlay rate for the SSN could be slower, as outlays for construction of the ship itself would begin one or two years later than normal.

Congress in the past has procured certain ships in the knowledge that those ships would not begin construction for some time and consequently would take longer to enter service than a ship of that kind would normally require. When Congress procured two nuclear-powered aircraft carriers (CVNs 72 and 73) in FY1983, and another two (CVNs 74 and 75) in FY1988, it did so in both cases in the knowledge that the second ship in each case would not begin construction until some time after the first.

ENDNOTES

[1] See CRS Report R41129, Navy Ohio Replacement (SSBN[X]) Ballistic Missile Submarine Program: Background and Issues for Congress, by Ronald O'Rourke.

[2] In U.S. Navy submarine designations, SS stands for submarine, N stands for nuclear-powered, B stands for ballistic missile, and G stands for guided missile (such as a cruise missile). Submarines can be powered by either nuclear reactors or non-nuclear power sources such as diesel engines or fuel cells. All U.S. Navy submarines are nuclear powered.

A submarine's use of nuclear or non-nuclear power as its energy source is not an indication of whether it is armed with nuclear weapons—a nuclear-powered submarine can lack nuclear weapons, and a non-nuclear-powered submarine can be armed with nuclear weapons.

[3] The SSBNs' basic mission is to remain hidden at sea with their nuclear-armed submarine-launched ballistic missiles (SLBMs) and thereby deter a strategic nuclear attack on the United States. The Navy's SSBNs are discussed in CRS Report R41129, Navy Ohio Replacement (SSBN[X]) Ballistic Missile Submarine Program: Background and Issues for Congress, by Ronald O'Rourke, and CRS Report RL31623, U.S. Nuclear Weapons: Changes in Policy and Force Structure, by Amy F. Woolf.

[4] The Navy's four SSGNs are former Trident SSBNs that have been converted (i.e., modified) to carry Tomahawk cruise missiles and SOF rather than SLBMs. Although the SSGNs differ somewhat from SSNs in terms of mission orientation (with the SSGNs being strongly oriented toward Tomahawk strikes and SOF support, while the SSNs are more general-purpose in orientation), SSGNs can perform other submarine missions and are sometimes included in counts of the projected total number of Navy attack submarines. The Navy's SSGNs are discussed in CRS Report RS21007, Navy Trident Submarine Conversion (SSGN) Program: Background and Issues for Congress, by Ronald O'Rourke.

[5] For an account of certain U.S. submarine surveillance and intelligence-collection operations during the Cold War, see Sherry Sontag and Christopher Drew with Annette Lawrence Drew, Blind Man's Bluff (New York: Public Affairs, 1998).

[6] For additional information on Navy force-level goals, see CRS Report RL32665, Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress, by Ronald O'Rourke.

[7] Los Angeles-class boats have a beam (i.e., diameter) of 33 feet and a submerged displacement of about 7,150 tons. Seawolf-class boats have a beam of 40 feet. SSN-21 and SSN-22 have a submerged displacement of about 9,150 tons.

[8] SSN-23 is 100 feet longer than SSN-21 and SSN-22 and has a submerged displacement of 12,158 tons.

[9] Virginia-class boats have a beam of 34 feet and a submerged displacement of 7,800 tons.

[10] For a discussion of MYP contracting, see CRS Report R41909, Multiyear

Procurement (MYP) and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress, by Ronald O'Rourke and Moshe Schwartz.

11 For a discussion of block buy contracting, see CRS Report R41909, Multiyear Procurement (MYP) and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress, by Ronald O'Rourke and Moshe Schwartz.

12 GD/EB and NNS are the only two shipyards in the country capable of building nuclear-powered ships. GD/EB builds submarines only, while NNS also builds nuclear-powered aircraft carriers and is capable of building other types of surface ships.

13 The joint production arrangement is a departure from prior U.S. submarine construction practices, under which complete submarines were built in individual yards. The joint production arrangement is the product of a debate over the Virginia-class acquisition strategy within Congress, and between Congress and the Department of Defense (DOD), that occurred in 1995-1997 (i.e., during the markup of the FY1996-FY1998 defense budgets). The goal of the arrangement is to keep both GD/EB and NNS involved in building nuclear-powered submarines, and thereby maintain two U.S. shipyards capable of building nuclear-powered submarines, while minimizing the cost penalties of using two yards rather than one to build a submarine design that is being procured at a relatively low annual rate. The joint production agreement cannot be changed without the agreement of both GD/EB and NNS.

14 The Navy says that, in constant FY2005 dollars, about $200 million of the $400 million in the sought-after cost reductions was accomplished simply through the improved economies of scale (e.g., better spreading of shipyard fixed costs and improved learning rates) of producing two submarines per year rather than one per year. The remaining $200 million in sought-after cost reductions, the Navy says, was accomplished through changes in the ship's design (which will contribute roughly $100 million toward the cost-reduction goal) and changes in the shipyard production process (which will contribute the remaining $100 million or so toward the goal). Some of the design changes are being introduced to Virginia-class boats procured prior to FY2012, but the Navy said the full set of design changes would not be ready for implementation until the FY2012 procurement. Changes in the shipyard production process are aimed in large part at reducing the total shipyard construction time of a Virginia-class submarine from 72 months to 60 months. (If the ship spends less total time in the shipyard being built, its construction cost will incorporate a smaller amount of shipyard fixed overhead costs.) The principal change involved in reducing shipyard construction time to 60 months involves increasing the size of the modules that form each submarine, so that each submarine can be built out of a smaller number of modules. For detailed discussions of the Virginia-class cost-reduction effort, see David C. Johnson et al., "Managing Change on Complex Programs: VIRGINIA Class Cost Reduction," Naval Engineers Journal, No. 4, 2009: 79-94; and John D. Butler, "The Sweet Smell of Acquisition Success," U.S. Naval Institute Proceedings, June 2011: 22-28.

15 "Navy Selects Virginia Payload Module Design Concept," USNI News

(http://news.usni.org), November 4, 2013.

16 Christopher P. Cavas, "Innovations, No-Shows At Sea-Air-Space Exhibition," Defense News, April 18, 2011: 4. See also Christopher P. Cavas, "U.S. Navy Eyes Dual-Mission Sub," Defense News, October 17, 2011; and Lee Hudson, "New Virginia-Class Payload Module May Replace SSGN Capability," Inside the Navy, October 24, 2011.

17 For an illustration of the VPM, see http://www.gdeb.com/news/advertising/images/VPM_ad/VPM.pdf, which was accessed by CRS on March 1, 2012.

18 Michael J. Conner, "Investing in the Undersea Future," U.S. Naval Institute Proceedings, June 2011: 16-20.

19 A Virginia-class SSN can carry about 25 Tomahawks or other torpedo-sized weapons in its four horizontal torpedo tubes and associated torpedo room, and an additional 12 Tomahawk cruise missiles in its bow-mounted vertical lunch tubes, for a total of about 37 torpedo-sized weapons. Another 28 Tomahawks in four mid-body vertical tubes would increase that total by about 76%.

20 Michael J. Conner, "Investing in the Undersea Future," U.S. Naval Institute Proceedings, June 2011: 16-20.

21 Lee Hudson, "Virginia Payload Module Cost Estimate Down To $350 Million Apiece," Inside the Navy, July 22, 2013. Previously, the Navy had testified that adding the VPM would increase the procurement cost of the Virginia class design by $360 million to $380 million in current dollars. (Source: Spoken testimony of Sean Stackley, the Assistant Secretary of the Navy for Research, Development, and Acquisition [i.e., the Navy's acquisition executive], at a May 8, 2013, hearing on Navy shipbuilding programs before the Seapower subcommittee of the Senate Armed Services Committee, as shown in the transcript for the hearing. See also Olga Belogolova, "Navy Officials Lay Out Fragility Of Shipbuilding Budget To Congress," Inside the Navy, May 10, 2013.) Prior to that, the Navy reportedly had estimated that adding the VPM would increase the procurement cost of the Virginia-class design by $400 million to $500 million. (Christopher P. Cavas, "U.S. Navy Eyes Dual-Mission Sub," Defense News, October 17, 2011; see also Michael J. Conner, "Investing in the Undersea Future," U.S. Naval Institute Proceedings, June 2011: 16-20.)

22 For more on this program, see CRS Report RS20643, Navy Ford (CVN-78) Class Aircraft Carrier Program: Background and Issues for Congress, by Ronald O'Rourke.

23 For more on the SBN(X) program, see CRS Report R41129, Navy Ohio Replacement (SSBN[X]) Ballistic Missile Submarine Program: Background and Issues for Congress, by Ronald O'Rourke.

24 Navy briefing entitled, "SSN Force Structure, 2020-2033," presented to CRS and CBO on May 22, 2007.

25 The requirement for 10.0 deployed SSNs, the Navy stated in the briefing, was the current requirement at the time the study was conducted.

26 The peak projected wartime demand of about 35 SSNs deployed within a certain amount of time, the Navy stated, is an internal Navy figure that reflects

several studies of potential wartime requirements for SSNs. The Navy stated that these other studies calculated various figures for the number of SSNs that would be required, and that the figure of 35 SSNs deployed within a certain amount of time was chosen because it was representative of the results of these other studies.

27 If shipyard construction time is reduced from 72 months to 60 months, the result would be a one-year acceleration in the delivery of all boats procured on or after a certain date. In a program in which boats are being procured at a rate of two per year, accelerating by one year the deliveries of all boats procured on or after a certain date will produce a onetime benefit of a single year in which four boats will be delivered to the Navy, rather than two. In the case of the Virginia-class program, this year might be around 2017. As mentioned earlier in the discussion of the Virginia-class cost-reduction goal, the Navy believes that the goal of reducing Virginia-class shipyard construction time is a medium risk goal. If it turns out that shipyard construction time is reduced to 66 months rather than 60 months (i.e., is reduced by 6 months rather than 12 months), the size of the SSN force would increase by one boat rather than two, and the force would bottom out at 41 boats rather than 42.

28 The Navy study identified 19 existing SSNs whose service lives currently appear to be extendable by periods of 1 to 24 months. The previous option of reducing Virginia-class shipyard construction time to 60 months, the Navy concluded, would make moot the option of extending the service lives of the three oldest boats in this group of 19, leaving 16 whose service lives would be considered for extension.

29 The Navy stated that the rough, order-of-magnitude (ROM) cost of extending the lives of 19 SSNs would be $595 million in constant FY2005 dollars, and that the cost of extending the lives of 16 SSNs would be roughly proportional.

30 In January 2005, the Los Angeles-class SSN San Francisco (SSN-711) was significantly damaged in a collision with an undersea mountain near Guam. The ship was repaired in part by transplanting onto it the bow section of the deactivated sister ship Honolulu (SSN-718). (See, for example, Associated Press, "Damaged Submarine To Get Nose Transplant," Seattle Post-Intelligencer, June 26, 2006.) Prior to the decision to repair the San Francisco, the Navy considered the option of removing it from service. (See, for example, William H. McMichael, "Sub May Not Be Worth Saving, Analyst Says," Navy Times, February 28, 2005; Gene Park, "Sub Repair Bill: $11M," Pacific Sunday News (Guam), May 8, 2005.)

31 Debt, Deficits, and Defense, A Way Forward[:] Report of the Sustainable Defense Task Force, June 11, 2010, pp. 19-20, 31.

32 Benjamin H. Friedman and Christopher Preble, Budgetary Savings from Military Restraint, Washington, Cato Institute, September 23, 2010 (Policy Analysis No. 667), pp. 9.

33 Lawrence J. Korb and Laura Conley, Strong and Sustainable[:] How to Reduce Military Spending While Keeping Our Nation Safe, Center for American Progress, September 2010, pp. 19-20.

[34] Debt Reduction Task Force, Restoring America's Future[:] Reviving the Economy, Cutting Spending and Debt, and Creating a Simple, Pro-Growth Tax System, November 2010, p. 103.
[35] For further discussion of China's naval modernization effort, see CRS Report RL33153, China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress, by Ronald O'Rourke.
[36] Stephen J. Hadley and William J. Perry, co-chairmen, et al., The QDR in Perspective: Meeting America's National Security Needs In the 21st Century, The Final Report of the Quadrennial Defense Review Independent Panel, Washington, 2010, Figure 3-2 on page 58.
[37] A Strong National Defense[:] The Armed Forces America Needs and What They Will Cost, Heritage Foundation, April 5, 2011, pp. 25-26.
[38] Department of Defense, Director, Operational Test and Evaluation, FY2013 Annual Report, January 2014, pp. 240-242.
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[51] In both FY1988 and FY1980, the Navy had a spare set of Nimitz (CVN-68) class nuclear propulsion components in inventory. The existence of a spare set of components permitted the carriers to be built more quickly than would have otherwise been the case, but it is not what made the single-year full funding of these carriers possible. What made it possible was Congress's authority to appropriate funds for the purpose.

CLANDESTINE MINE COUNTERMEASURES: COUNTERING UNSINKABLE SUBMARINES IN CHINA'S *ASSASSIN'S MACE*

by LCDR Sean Kido, USN

Lieutenant Commander Kido was born in Honolulu, Hawaii. He graduated from the University of Washington with a bachelor's degree in Business Administration and earned his master's degree in National Security and Strategic Studies from the U.S. Naval War College. His operational assignments include: USS GRAPPLE (ARS 53); Explosive Ordnance Disposal Mobile Unit (EODMU) THREE Detachment FIVE; EODMU FIVE Platoon 501; Operations Officer, Mobile Diving and Salvage Unit ONE; and Resources, Requirements, and Plans Task Force 52/Mine Countermeasures Squadron FIVE (N5N8) in Bahrain. During these assignments he has deployed to the Arabian Gulf, Iraq, Korea, the Western Pacific, and Bahrain.

LCDR Kido's designations and qualifications include Explosive Ordnance Disposal Warfare Officer, Mine Countermeasures Planner, Basic Diving and Salvage Officer, Surface Warfare Officer, and Naval Parachutist. His personal awards include the Bronze Star (with Combat V), Navy Commendation Medal (Gold Star in lieu of fifth award), Navy Achievement Medal (Gold Star in lieu of second award), and various service and unit awards.

LCDR Kido assumed his present duties as Executive Officer, Naval School Explosive Ordnance Disposal in October 2014.

Introduction

Over the past two decades, China has modernized its mine warfare capabilities to include moored, bottom, drifting, rocket-propelled, and intelligent mines.[1] No satisfactory solution has been

found to counter these intelligent mines efficiently.[2] Today, mixed minefields with intelligent mobile mines capable of delayed arming, persistent presence, deep water and stealth deployment, and sophisticated fuzing could act as unsinkable attack submarines wherever employed.[3] Water depths throughout the Taiwan Strait, and within what China considers the First Island Chain and many of its associated choke points are shallow enough for many types of People's Liberation Army Navy (PLAN) mines.[4] The PLAN has also expanded its domestic research and development program for underwater weapons that increases the operational security (OPSEC) of its mining program.[5] While the U.S. Navy has traditionally neglected mine warfare (MIW), these developments challenge U.S. Pacific Command's (USPACOM) ability to attain sea control, which has been a precursor to victory in armed conflict and is necessary for the success of all naval missions.[6] This challenge puts surface and subsurface control at risk.[7] Naval mines represent anti-access area denial (A^2AD) threats, which "are the only naval weapons capable of altering geographical conditions, by making certain sea areas impassable to the enemy's ships."[8] The PLAN considers its mine warfare program an "assassin's mace."[9] In short, naval mining could challenge, and even prevent, the United States from gaining and exploiting sea control.

China's growing mine warfare program represents an emerging A^2AD threat that challenges USPACOM's ability to gain surface and underwater superiority in a future naval confrontation. This challenge necessitates a U.S. clandestine mine countermeasures (MCM) force that would offer the ability to gain sea control in a contested environment against mine threats employed in the waters around Taiwan, the *First Island Chain*, or other disputed areas in the East and South China Seas.

A Clandestine MCM Force

A clandestine MCM force would fundamentally require the ability to operate in a secret or concealed manner, which can be facilitated by special operations force (SOF)-capable Ohio or Virginia-class submarines. Ohio-class submarines are ideally

suited to accommodate: up to 66 integrated SEAL and Navy Explosive Ordnance Disposal (EOD) mission forces; unmanned undersea vehicles (UUV); and specialized equipment to sustain forward-deployed operations in support of combatant commander tasking.[10] Two permanent lock-out chambers, which can accommodate Dry Deck Shelters (DDS), allow clandestine insertion and retrieval of substantial numbers of these personnel.[11] Newer Virginia-class submarines are similarly suitable for large numbers of SOF personnel and equipment supported by large lock-in/lock-out chambers.[12] These lock-in/lock-out chambers give a clandestine force and its associated equipment the ability to exit and reenter a submerged submarine.

UUVs provide excellent reconnaissance and mine hunting capabilities. Currently available technologies have demonstrated 315-mile and 109-hour mission endurance profiles which could provide substantial mine location and avoidance capabilities.[13] SEALs and Navy EOD personnel could provide mine reacquisition and neutralization capabilities as deep as 300 feet, adequate to create pockets of subsurface superiority in certain areas. Besides clandestine diving operations, remotely operated vehicles from a submarine launched combat rubber raiding craft could be employed where the hazards of diving operations exceed the risk of surface detection.

These integrated submarine, UUV, SEAL delivery vehicles (SDV), SEAL, and EOD forces would comprise clandestine MCM units capable of full spectrum mine countermeasures ready to operate far forward of conventional forces in support of the combatant commander's objectives to gain sea control.

Attack Layered and Integrated Enemy A^2AD in Depth

The ability to exploit sea control in order to project influence and power ashore is a fundamental component of credible combat power.[14] Attaining sea control requires surface, subsurface, airspace—and today space and cyberspace—control.[15] This requires a multi-disciplined and synchronized approach to obtaining sea control across these domains. A clandestine MCM force would enhance the synchronization and sequencing of mine

warfare efforts with this joint force to neutralize the challenge posed by mines to achieve sea control.

Today, U.S. and allied MCM forces are not built to operate where sea and air control are contested.[16] U.S. Avenger-class MCM ships are expected to operate in the "least severe environment, away from… the general war-at-sea region."[17] Littoral Combat Ships (LCS), the next generation MCM platform, are also meant to withdraw if one takes substantive damage rather than to continue operations.[18] Pragmatically, these constraints delay operational-level active MCM efforts until sufficient air and surface sea control are attained, and geographically limits sustained MCM efforts to these areas where local air and surface superiority have been secured. This operational luxury may not be feasible in the East Asian maritime threat environment.

A clandestine MCM force, able to deploy within waters challenged by Chinese missile and surface threats, would enable MCM efforts in the subsurface domain to be conducted concurrently with a contest to control the air and surface domains. In keeping with operational access precepts from the Joint Operational Access Concept 2010 (JOAC), this low-signature force would leverage the undersea environment to project force with limited exposure to enemy fires.[19]

These integrated capabilities would expand on the submarine and large diameter UUV (LDUUV) integration advocated by Vice Admiral Michael Connor, Commander U.S. Submarine Forces (USSUBFOR) and former director of the U.S. Navy's Submarine Warfare Division.[20] Clandestine mine surveillance, reconnaissance and detection capabilities, once identified as the U.S. Navy's top mine warfare priority, could be augmented by EOD identification, neutralization, and technical intelligence gathering capabilities.[21] This would enable the joint force to counter undersea A^2AD defenses in depth, forward of the front line, as advocated by the JOAC, rather than simply detecting them and rolling back those defenses from the perimeter.[22]

An alternate position is that defensive MCM operations are not required in initial combat phases, but better suited for maintaining lines of communication to rear areas. Efforts to reduce

the threat of mines should predominately focus on offensive MCM, which inhibit an adversary's capacity to employ naval mines.[23] Defensive MCM to remove mines that are present, conducted by the MCM Triad (MCM ships, MH-53E helicopters, and EOD divers), must progress from the outer perimeter inward due to its vulnerability while offensive MCM, though more escalatory, preemptively attacks an adversary's mining capabilities on land and at sea. Air superiority is necessary to execute both offensive and defensive MCM. Once mines are in the water, the time required to neutralize them is significant and irreducible. Limited risk can be assumed with low-density MCM Triad forces. Therefore, offensive MCM should be the focus of effort. Offensive MCM should sufficiently limit the number of mines an adversary deploys, thus the risk from mine strikes to other surface combatants will be acceptable.

This line of reasoning, however, is based on a politically risky over reliance on offensive MCM and overconfidence in its totality. Dr. Scott Truver, Director of National Security Programs at Gryphon Technologies and a collaborator in the interagency task force which drafted the President's National Strategy for Maritime Security (2005), provides three reasons that reliance on offensive MCM is not sufficient: diplomatic restraint fearful of escalating crisis; adequate time for mining to occur before strike assets could arrive on the scene; and challenges to identifying whether a vessel was carrying mines or not.[24]

While the U.S. might enjoy superior strike capabilities, it cannot assure operational access or sea control alone. The Democratic People's Republic of Korea (DPRK) minelaying operations at Wonsan during the Korean War exemplify shortcomings of offensive MCM. Despite intelligence and evidence of DPRK mining, offensive MCM could not prevent the enemy's deployment of 3,000 mines, denying the U.S. led United Nations Command (UNC) sea control and the ability to project power ashore. Rear Admiral Allan E. Smith, Commander, Amphibious Task Force reported: "We have lost control of the seas to a nation without a navy, using pre-World War I weapons,

laid by vessels that were utilized at the time of the birth of Christ."[25]

Similarly, forty years later, "[T]he U.S. Navy lost command of the northern Arabian Gulf to more than 1,300 mines that had been sown by Iraqi forces virtually under the 'noses' of multinational coalition naval forces constrained by their rules of engagement."[26] Although the chain of command knew that Iraq was laying mines, it restrained U.S. Naval Forces from tracking and attacking minelayers "for fear of starting the war early."[27] DPRK and Iraqi minelaying, despite U.S. air superiority supported by adequate intelligence, demonstrated that "for all its value, air superiority cannot *replace* one's control of the surface and subsurface,"[28] and that offensive MCM cannot replace defensive MCM. Similarly, prematurely accepting risk to surface combatants by assuming low mine presence due to an overconfidence based on offensive MCM ignores the fact that even limited mining has damaged or sunk four times more U.S. Navy ships (post-WWII) than all other means of attack at sea.[29]

Attacking enemy A^2AD defenses in depth is a fundamental precept of operational access.[30] Taking this approach against naval mine warfare networks is imperative, but should not rely too heavily on offensive MCM to prevent effective adversarial minelaying. MCM forces must be able to attack the mine threat throughout the battlespace, not just from the perimeter. To do so, a less vulnerable MCM force is needed. Leveraging stealth capabilities would increase the survivability of allied MCM effort through a less vulnerable capability and platform.

Leverage Stealth

The surface MCM force is currently operating at historically low capacity, making the survivability of MCM capabilities as critical as ever. On December 7, 1941 the U.S. Navy's 135 mine warfare ships represented 17 percent of its total fleet at the outset of WWII.[31] The mine warfare force peaked at 614 ships by the end of WWII, and steadily remained at 8-10 percent of the fleet until 1970.[32] Between 1970 and 1974 the surface MCM force declined from 64 to 9 ships in response to: Chief of Naval Operations

(CNO) Admiral Zumwalt's policy decision to increase the size of the airborne MCM force; Department of Defense (DoD) cancellation of future shipbuilding programs; routine ship decommissions and transfers to the reserves; and MCM ship sales to allied navies.[33]

Accordingly, the current surface MCM force remains comparatively and insufficiently small. In 2011, Dr. Truver argued that, due to limited capacity of its aging platforms, the effectiveness of U.S. MCM responses to PLAN mining inside the First Island Chain or the Taiwan region is unclear and precarious.[34] This would remain true even after the anticipated fielding of LCS-based MCM capabilities to the fleet, which would adequately support MCM operations on the order of another Operation DESERT STORM, but likely be understrength against more formidable PLAN mining capabilities.[35] Similarly, the current airborne MCM force, which had offset the surface MCM force structure of the 1970s, would be of limited effectiveness in the contemporary environment until air superiority could be gained in an East Asian scenario. Loss of a single MCM ship in a conflict would represent a much greater loss of warfighting capacity today than in past conflicts and would create a damaging effect in today's 24/7 global information environment (images of burning or sinking U.S. warship repeatedly broadcast around the world) and casualty-averse U.S. public.

Integrating submarine, SEAL, and EOD forces with UUVs into a clandestine MCM force would greatly mitigate the susceptibility of the operational level MCM effort to combat losses, as "submarines represent the only highly survivable maritime asset of the United States and its maritime partners."[36] A submarine-based clandestine MCM force would fundamentally complicate enemy targeting of U.S. MCM capabilities by utilizing stealth and ambiguity. Besides creating a less susceptible MCM force, a clandestine MCM force would also increase the tempo, speed, and survivability of active surface MCM units.

A clandestine MCM forces would be able to gain early intelligence on underwater threats. Pinpointed location, mine type, and fuze settings would increase dedicated-MCM operational tempo.

Instead of going through the time consuming task of locating, classifying, and identifying mines, the surface MCM force could proceed more directly to mine relocation, prosecution, and neutralization or more rapid exploitation. In the case that minesweeping (efforts to incite a safe detonation when precisely locating mines is unreliable) is a more desirable tactic, confirmed types and fuzing could more specifically inform minesweeping planners. This would increase the effectiveness and efficiency of sweeping efforts. The intelligence that a clandestine MCM force could collect might also provide known safe areas and routes, increasing the freedom of maneuver for friendly forces less constrained by self-protective measures such as reduced speeds.

On the other hand, one might argue that current MCM and future LCS platforms meet the necessary survivability requirements for their anticipated operations and projected operating environment.[37] This counter position invokes renowned naval theorist Sir Julian Corbett who "focused on the importance of sea lines of communication rather than battle,"[38] protecting power ashore through support to the Army, and views MCM forces' primary role as maintaining lines of communications where surface and air threats have been neutralized. Therefore, this argument continues, extensive MCM is not required *during* combat operations. Supposing that MCM could be conducted in benign environments where sea and air control have been attained, this position discounts the threat to MCM forces. It likewise discounts the threat to surface combatants from mines that should be detected and avoided. This thinking would perpetuate avoidance tactics and acceptance of residual risk; such thinking led to Admiral David Farragut's famous orders at Mobile Bay in 1864: "Damn the torpedoes!"[39] This position may have suited its 1864 context, but carries too much risk today. With MCM efforts sequenced after combat operations, MCM capacity could be apportioned to counter threats to lines of communications, not threats to combat forces. The U.S. airborne MCM forces and allied MCM forces could be leveraged to mitigate reduced surface MCM force capacity if confronted by an extensive mining campaign.

This seductive but flawed logic, however, is predicated on the assumption that submarines are the only undersea threat that can deny sea control. It remains blind to naval mines' ability to deny sea control. It dismissed mine warfare's asymmetric impact due to limited scope. It ignores the requirement of MCM capabilities in combat environments as demonstrated in Korea where MCM forces, accounting for 2 percent of all naval forces, suffered 20 percent of all naval casualties.[40] It also ignores lessons from Operation IRAQI FREEDOM (OIF), where Rear Admiral (Ret.) Mike Tillotson, then Commander Task Force 56 (U.S. Fifth Fleet) and later Commander Naval Expeditionary Combat Command (NECC), reported that MCM "was undertaken in a… [less than] 'benign' environment."[41] This approach also assumes contributions from airborne MCM forces that may not be feasible without air superiority. Assuming allied MCM support from regional actors such as Taiwan, Japan, and the Republic of Korea is fraught with risk. These regional allies' MCM capacity will likely be dedicated to their own ports and territorial waters out of necessity or political preference to remain on the defensive.[42] They will also likely be out of range and sensitive to the political risk of supporting U.S. MCM efforts in the wider First Island Chain or South China Sea. Finally, it relies on avoidance *tactics* as a substitute for operational warfare that would include MCM along essential lines of operations.

Understating adversarial minelaying capacity, scope, and effect through the historical lens may also be misleading. Analysis of PLAN mine warfare techniques, conducted by the U.S. Naval War College's China Maritime Studies Institute, demonstrates that "Chinese MIW is robust and would not resemble either Iraqi or North Korean efforts in its scope or breadth."[43] Additionally, projected LCS numbers will likely be insufficient to combat a formidable PLAN mining campaign.[44] It fails to acknowledge that China's aggressive domestic research and development in mine warfare programs might complicate minesweeping operations. Finally, overstating the ability to avoid mines would ignore the fact that 11 of the 15 U.S. ships sunk or damaged by mines since WWII did not know they were operating in minefields.[45] Greater

efforts should be made to protect friendly forces conducting combat operations within potentially mined areas. Clandestine MCM forces could improve that protection.

Protect Friendly Advantages

Protection of friendly forces is a critical operational function and is even more crucial to protecting friendly comparative advantages. The U.S. Submarine Force is a comparative advantage that Chinese strategists would likely target.[46] Antisubmarine mines such as the C-1, C-3, EM-57, M-3, M-4, PMK-1, and PMK-2 can be deployed at various water depths ranging from 6 to 1000 meters.[47] Employed within the First Island Chain and China's near seas, a combination of these and other mines could challenge U.S. Submarine Forces' freedom of maneuver aiming to prevent entry and exit from China's near seas.[48] This could complicate a joint force commander's efforts to mass forces at a desired point and time, disperse forces in the operating area, maintain the initiative, and sustain speed and operational tempo.

In the summer of 1918, while fighting WWI, the United States and United Kingdom laid nearly 73,000 mines with 10 minelayers to blockade the 250-mile channel during the North Sea Barrage.[49] The North Sea Barrage was effective in reducing German U-Boat freedom of maneuver and sank at least six submarines during the war.[50] A clandestine MCM force could improve friendly submarine freedom of maneuver against similar mining efforts, by either clearing mine threats or locating and marking them so that they could be avoided. This would create reduced-threat ingress and egress routes, allowing forces to mass where and when desired in order to maintain the initiative.

Chinese strategists believe that "submarines are acutely vulnerable to mines, because passive sonar is not likely to be effective in locating mines, and because submarines have very limited organic MCM capabilities."[51] Chinese planners highlight rocket mines as an ideal and highly effective means for targeting U.S. submarines.[52] A clandestine MCM force could help protect submarines against these threats, and enhance joint force surveillance and reconnaissance capabilities. Large diameter and

long duration UUVs could locate mine-like objects at great distances. SDVs could transport EOD and SEALs over long ranges to identify and neutralize mines, while submarines reluctant to employ active sonar avoid the affected area. Locating, identifying, and neutralizing adversary antisubmarine mines would provide a direct means of protecting the submarine force while preparing the battlespace for follow-on forces.

Neutralizing naval mines with a clandestine MCM force could also leverage surprise. Creating and exploiting access to areas otherwise considered denied or protected by the adversary would inject ambiguity and uncertainty into an adversary's campaign, frustrating or complicating adversarial planning and decision making. This could draw an opponent's focus away from other offensive actions, deny momentum, and force a shift back to defensive actions.

Some might argue that even during conflict China would not utilize naval mines to an extent that would endanger U.S. submarine freedom of maneuver or safety. The Hague Convention of 1907 and other international laws would prohibit mining in international waters in peacetime unless international shipping is warned of their location. Such warning would provide U.S. planners ample intelligence to the location of mines that could be avoided. Intelligence and surveillance assets could also provide strategic and operational warning, allowing U.S. forces time to limit adversarial mining sufficiently. Under this logic, they would presume that mining would only occur after the outbreak of hostilities with sufficient indications and warnings (I&W) to allow U.S. naval forces to take advantageous positions and seize the initiative. U.S. forces could penetrate the First Island Chain before mines were placed. This combination of international laws to compel PRC self-restraint, and U.S. military forces' ability to take positions that would threaten minelaying operations based on adequate I&W provides an underlying deterrent to extensive PRC mining.

However, the assumption that China would restrain itself from extensive mining, exhibits a time-tested fallacy of joint planning; planning that is based on adversary intentions and not capabilities.

This also ignores other crucial factors: the 50,000-100,000 mines in China's inventory; arming-delay devices that allow placement of bottom mines up to 250 days before activation; and Chinese submarines that could carry and lay mines well before hostilities started.[53] Furthermore, it ignores the potential for China to seize the initiative early in a conflict with hundreds of bombers and fighter-bombers, and thousands of mechanized fishing trawlers and vessels that could overtly lay mines under the umbrella of early air defenses.[54] During WWII, the United States and United Kingdom laid approximately 100,000 naval mines intended for offensive purposes that sank or severely damaged 2,665 Axis ships.[55] Reliance on Chinese reluctance or adherence to legal restrictions ignores the potential for a Chinese mine warfare campaign to resemble Allied WWII efforts more than Iraqi or Korean War mining efforts. It also adheres to deterrence theory when the initiation of hostilities may have already signaled its breakdown.

Additionally, assuming the time to take advantageous positions and seize the initiative through offensive strikes assumes the absence of political restraints encountered during OIF and implied in the Air-Sea-Battle concept (U.S. forces might withstand an initial attack).[56] And, presumably taking these advantageous positions assumes a high risk to maritime forces. U.S. submarines would risk transit through potential antisubmarine minefields to an even higher mine-threat density East China Sea, while facing PLAN submarines with full knowledge of the types and location of PLAN mines. It also assumes an optimistic degree of surface combatants' self-protective capabilities, in light of the fact that of the U.S. Navy damaged or sunk by mines ships since WWII 73 percent of those ships did not know they were operating in minefields.[57]

Conclusions

Advancements in naval mine technologies and mobility have increased mine warfare's prominence in sea control. Adversarial mining campaigns in future conflicts have the capability and capacity to resemble WWI and WWII mining efforts in scope and

breadth while utilizing twenty-first century technology that has dramatically increased their effectiveness, intelligence, and lethality.

PRC aggression against disputed territories, contentious air defense zones, an increasingly capable military, and development of even more sophisticated naval mines and missiles have demonstrated an increased proclivity to exert aggressive territorial claims and growing A^2AD capabilities. Anti-access/area-denial methods challenge U.S. power projection, in an attempt to checkmate U.S. decision makers' options through sea-denial. With planned reductions in U.S. ground forces, the United States will increasingly rely on its maritime components to provide the operational access, forward presence, and power projection vital to U.S. national interests, especially in the inherently maritime East Asian region. This requires credible U.S. combat power to enable access despite underwater A^2AD threats in order to maintain stability and effectively deter conflict.

The surface MCM force of today is comparatively small and relies on AMCM assets which require air superiority to a greater degree than in pre-Vietnam era conflicts. This air superiority is challenged by Chinese A^2AD air defenses that necessitate a modification to U.S. MCM methods of employment. Combat losses of MCM forces during Korea and continued employment of MCM forces during OIF in uncontrolled areas have demonstrated the requirement for survivable MCM forces to be able to operate in contested environments.

While air superiority remains an important element of sea control, it cannot replace control of the surface and subsurface environments. A clandestine MCM force can be assembled with existing submarine, EOD, and SDV forces and large diameter UUVs to provide a method of employment that does not rely on air superiority. These forces can conduct operations to support gaining sea control while air control remains contested.

Lines of effort that include legacy MCM forces, future LCS developments, offensive MCM actions, and international law are all required to combat the threat of adversary mining. But these efforts must be augmented with the development of clandestine

MCM forces. These MCM forces could disrupt adversary planning and decision making, and operate in depth to favorably change the balance of space, time, and force through stealth and surprise. They would accelerate and enhance the synchronization of MCM efforts, increase protection to friendly submarines and ships, and further empower operational commanders to mass forces effectively at desired points and times. These advantages would enable a Joint Force Commander to achieve the sea control necessary for power projection more effectively and efficiently.

Recommendations

Assembling a clandestine MCM force from existing units could be done adequately in phases to accelerate integration training and proficiency. ***But it must start now***. The following list of recommendations is offered for consideration to enable this rapid integration:

1. USSUBFOR: Integrate Large Diameter UUVs with Submarine Forces

First, UUV-enabled intelligence, surveillance, and reconnaissance capabilities should be integrated with the submarine force. Specific training could be conducted for MCM operations such as identifying and training a portion of submarine crews as MCM planners at the Mine Warfare Training Center. Additional UUV employment and post-mission analysis skills could be trained through classroom and practical exercises. Contractor and military personnel experienced in UUVs operations from COMFIFTHFLT, and UUV operators from the Naval Oceanography Mine Warfare Center (NOMWC), could provide further baseline training. UUV and submarine integration exercises could proceed as designed by U.S. Navy's Submarine Warfare Division.

2. Naval Special Warfare Command, NECC: Integrate EOD MCM and SDV

Specific training could be conducted to integrate EOD and SDV team tactics such as swimmer lock-out and lock-in

procedures, safe transit speeds, safe standoff distances, underwater navigation, mine identification, and mine neutralization procedures for single and multiple ordnance items. Integration should continue with SSGN crews proficient in SOF support operations.

3. SEVENTH Fleet, THIRD Fleet: Conduct Fleet Exercises

Once adequate training has been completed, integrated full mission exercises could be conducted to leverage a full MCM locate-to-neutralize cycle to include the use of clandestine MCM capabilities. Clandestine MCM force training and exercises should be conducted in operating environments similar to those expected within the First Island Chain and Taiwan Strait.

4. USPACOM: Integrate Clandestine MCM Capabilities into Existing Operational Planning (OPLANs, CONPLANs, and Crisis Action Planning)

Clandestine MCM capabilities should be integrated into existing plans in order to ensure planners are able to leverage its unique capabilities. Plans should focus on the ability to modify the operational factor of space in combat environments, identification of decisive points for clandestine MCM employment, protection of submarine forces operating far forward of surface forces, and surveillance capabilities to accelerate follow-on MCM force operations.

5. Joint Force (as assigned): Maintain High Priority in Targeting Adversarial MIW Networks Early to Reduce Minelaying Capacity

Clandestine MCM will not replace legacy or future MCM development programs. Active (defensive) MCM efforts by the MCM Triad cannot replace offensive MCM. A high priority must be maintained in strengthening both capabilities, as well as targeting adversarial mine warfare networks including: mine inventories; transportation networks; assembly areas; loading sites; and minelaying platforms on land and at sea. Offensive MCM will remain vital to reducing and minimizing adversarial mining where

possible. Defensive MCM will remain vital to gaining and maintaining sea control.

6. NAVSEA 00C, Navy Experimental Diving Unit: Conduct Diving Physiology and Equipment Testing/Development to Increase Operational Capabilities

Adversarial mining depth capabilities have increased over time and, today, include mine threats with depths in excess of 1400 feet.[58] Current MCM diving is restricted by equipment limitations to depths of 300 feet while Navy divers have been able to dive as deep as 2000 feet.[59] Additional equipment research and development could increase the depth capabilities of MCM diving required by the MCM operating areas expected throughout choke points in the First Island Chain and Near China Seas. Diving physiology research with dive profiles modified to meet this projected operating environment could extend operational capabilities.

ENDNOTES

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ESTIMATED PROPULSION CHARACTERISTICS OF THE NEW BOREY CLASS RUSSIAN SSBN

by Mr. Bruce Rule

Bruce Rule, for 42 years, has been the lead acoustic analyst at the Office of Naval Intelligence. In 2003, he wrote the Navy position-paper on the acoustic, dynamic and temporal characteristics of submarine pressure-hull and bulkhead collapse events. In 2009 he provided the Navy with the first reanalysis of acoustic detections of the loss of the USS SCORPION in 40-years which confirmed that disaster was the result of a battery explosion.

Summary

Information from open sources (footnoted below) provides the basis for estimating that the new BOREY Class Russian SSBN (Project 955) will reduce the detectability of reduction-gear noise by employing a hybrid propulsion system with a turbo-electric (TE) mode for patrol and low-speed transit operations while retaining a turbine-reduction (TR) capability for speeds above about eight knots.

Note: a Sep 2013 article[1], quotes RADM Richard Breckenridge and others that the OHIO Replacement SSBN will have an electric propulsion system to make them quieter than currently operational US SSBNs. The new system will employ high-speed turbo-generators to power a very large, electric motor to directly drive the propeller ((the motor armature (rotor) is the propeller shaft)) thus eliminating the need for reduction gears and the noise they produce.

It thus appears Russia and the US have, respectively, already taken or will take a similar approach to reducing the acoustic detectability of their strategic submarine assets. The BOREY TE

propulsion mode to be employed only during patrol and low-speed transits with the main propulsion turbine (TR mode) declutched in a "ready status" (Russian term). The US design will accommodate the entire speed range.

Discussions of the BOREY Class Russian SSBN Hybrid Propulsion System

The BOREY Class uses a single-shaft steam turbine plant, the GTZA OK-9VM rated at 50,000 shaft horsepower[2], the same system installed on all AKULA Class (Project 971) SSNs[3] Note: the acronym GTZA abbreviates (and translated as) "main turbine gear assembly" which indicates BOREY and AKULA Class submarines may employ the same design reduction gear.

The BOREY also has a 5,576 metric hp (5,550 hp) motor,[4] exactly the same rating as the PG-141 dc propulsion motor used by Project 877 KILO Class diesel submarines[5]. The use of such a large dc motor (volume of about 380 cubic feet) would appear to be limited to a propulsion application on the BOREY with (rectified) power supplied by two 3,200 kW ship's service turbo-generators[3]. Unless the motor has been highly modified to accommodate a *shaft-centric* installation—in which case it probably would have a new designation—the BOREY may employ a single-stage reduction gear to transfer power from the motor to the propeller shaft. Based on the reasonable assumption that the BOREY will have a turns-per-knot value of about 10 at patrol-mode speeds, a reduction ratio in the range of about six will be required to permit the PG-141—or a similar motor - to operate in an acceptable speed range. (The PG-141 has a maximum speed of 500 rpm.) So, there is no *free lunch*. A reduction gear will still be required for the BOREY TE propulsion mode, albeit a relatively small, single-stage system compared to the much larger multi-stage gear system associated with the TR propulsion mode using the GTZA OK-9VM.

Comments

Comparing the Russian and US approaches to the problem of reducing gear noise provides another example of the differing

design philosophies. The US OHIO Replacement will be an entirely new design while the Russian BOREY probably will use existing propulsion system components, the GTZA OK-9VM main turbine gear assembly first employed in 1984 in the lead AKULA Class SSN, and the PG-141 dc motor first used in 1963 in JULIETT Class SSGs.

The Soviet-Russian axiom "Better is the enemy of good enough" (often associated with ADM Sergey Gorshkov, Commander-in-Chief of the Soviet Navy 1956-1985) is evident with the off-the-shelf GTZA OK-9VM and PG-141 propulsion systems being *good enough* for use in the new BOREY Class SSBN.

This approach potentially gains the primary advantage (noise reduction) of a low-speed TE propulsion capability while avoiding the cost of developing new propulsion system components, especially the very large electric motor that would allow the BOREY to retain a speed capability of more than 20 knots but would create significant installation and possibly trim problems.

In an analogous situation, the Soviets reduced the acoustic vulnerabilities (cavitation) of Project 877 KILO Class SS units (created by the use of the PG-141 dc motor to drive the propeller at speeds as high as about 500 rpm) by using the PG-141M motor on Project 636 KILOs. It is assessed the PG-141M (M for Modification) uses a *built-in reducer* (a Soviet term for a reduction gear built into the motor) to reduce the maximum propeller shaft speed from 500 to 250 rpm. From space and weight considerations, the most probable gear system is a planetary epicyclic star design: sun gear input, planet carrier fixed, ring-gear output. Star systems can accommodate reduction ratios between 2:1 (the Project 636 KILO value) and about 11:1. This was a simple, cheap and effective solution to the Project 877 KILO cavitation problem. The change from a flat-faced six-bladed propeller on Project 877 hulls to a skewed seven-bladed propeller for Project 636 hulls also helped.

This assessment of the KILO is based on the use of the same motor designation (PG-141) by Project 877 and Project 636 KILOs and the fact that a dc motor that produces 5,500 hp at 250

rpm would have approximately twice the volume of a motor that produced 5,500 hp at 500 rpm and would thus be difficult to install on Project 636 hulls from both space and weight standpoints.

If the Russians need to further reduce the acoustic noise levels of the new Project 636.3 KILO, they could use a reduction gear with the three-to-one ratio which was employed by the single BELUGA Class SS. This would result in a maximum propeller shaft speed of about 170 rpm for Project 636.3 units. Note: the BELUGA, which had *advanced hull architecture*, could achieve 26.6 knots at 170 rpm for a turns-per-knot value of 6.4. (All KILO/BELUGA information open source.)

ENDNOTES

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ARCTIC SEA DISASTER

by Mr. Don Messner

Ed. Note: Mr. Messner qualified in DIODON (SS-349) and served from 1954-1957. He subsequently spent 30 years as a microwave engineer in the defense industry with companies such as Litton Industries and Boeing Aircraft.

The 25th of August 1949 marked a cold day in history in more ways than one. The first U.S. Submarine casualty after World War II occurred. The submarine COCHINO was heading home having completed one of the first Cold War patrols off the coast of northern Russia – Murmansk area to be exact, home of the Soviet Fleet. While transiting off the coast of Hammerfest, Norway, COCHINO experienced a tremendous explosion in the after battery well which resulted in an uncontrollable fire determining her fate.

USS COCHINO SS-345 was one of the Navy's newest and finest submarines in the fleet of 80 in 1949. She was built by Electric Boat (EB) Company in Groton, CT and was the second submarine commissioned after the end of World War II. VJ Day was 15 August 1945 and COCHINO was commissioned on 25 August shortly after the USS MERO SS-378, was commissioned on the 17th at Manitowoc Shipyard in Manitowoc, WI. She was a Balao class boat, often referred to as a thick skin boat with a test depth of 412 feet to differentiate it from the previous Gato class, thin skin boats which had a test depth of 312 feet. She had just been converted to a Guppy II at EB in February of 1949. A Guppy II conversion consisted of modernizing a WWII Fleet boat by streamlining the bow, streamlining and enclosing the top side superstructure with a sail, striping off the top side armament, removing the small auxiliary generator (the dinky), adding a snorkel within the streamlined sail and changing the battery configuration from two main batteries with 126 cells each to four main batteries with 126 high capacity cells each.

In early August 1949, COCHINO departed the British Naval Base at Londonderry, North Ireland where she had been outfitted with a German designed GHG experimental passive sonar. The Brits were more sonar savvy than the Americans and this design *captured* from the Germans at the end of WWII was recognized as superior to anything the Allies had. The same scenario applied to the snorkel where as late in WWII, the U-Boats were using a Dutch designed *schnorkel*. U-Boat crews hated it as it was clumsy and time consuming to rig but mainly because if depth control wasn't accurately kept and the valve's sensors got wet, it would cycle (shut) and the engines would draw a vacuum in the boat – a most unpleasant feeling for the crew – an experience difficult to relate to unless personally experienced. It clearly needed refinement.

Upon leaving Londonderry, COCHINO rendezvoused with USS TUSK (SS-426) and headed for the Arctic Ocean. Their original mission was to test the experimental sonar and significantly modified snorkel system in the cold water environment by playing the traditional cat and mouse games, i.e., one is the prey and *hides* and the other tries to out guess and find her. COCHINO, however, had a change in priorities. While being fitted out with the new sonar in Londonderry, an intelligence agent (often referred to as a spook) joined the crew for a top secret mission which superceded her previous mission with TUSK. The Spook, a navy white hat, brought aboard some special equipment such as radios, recorders, antennas as well as special orders. COCHINO's priority now was to covertly eavesdrop on the Russians off Murmansk and intercept and record radio, radar and beacon transmissions as well as catalog *propeller count* of navy and merchant ships in the area and look for missile testing activity.

COCHINO and TUSK parted company at the Arctic Circle but would later rendezvous when COCHINO's top secret mission was completed. (the Story about COCHINO's Spook mission is the focus of Chapter 1 in Blindman's Bluff – see bibliography). Upon completion of her covert mission, COCHINO departed the Murmansk area in the Barents Sea and headed west for the

confines of the Greenland/Norwegian Seas and her date with TUSK 400 miles north of the Arctic Circle.

At about 0800 on the 25th of August while running submerged in an operation with TUSK, COCHINO was rocked by an explosion. Within seconds the report, "Fire in After Battery", came to the conning tower and Commander Rafael C. Benitez the Commanding Officer (CO). Benitez immediately ordered the boat to surface—he had to ventilate it. (Fire is one of the diesel submariner's three worst enemies, the other two being Hydrogen gas and Chlorine gas—not necessarily in that order). The Executive Officer (XO), Lt. Cmdr. Richard M. Wright, immediately formed a fire fighting party of five. He was in the Forward Engine Room, the compartment immediately aft of the After Battery compartment, with 18 crew men with him in the engine spaces. The After Battery compartment was now isolated but not before acrid fumes and gases had spread forward and men were passing out. In the next few minutes, the forward compartments were evacuated and 60 men were brought topside and lashed to the superstructure, some in their underwear, to face the turbulent North Atlantic seas and frigid temperatures.

Word came to Benitez that a short circuit between Battery #3 and Battery #4 had caused the fire and one of the batteries was now effectively charging the other and creating extremely volatile hydrogen gas, another of the submariner's worst enemies. Electricians were trying to remove the short from the Maneuvering Room control panel when at 0836 two seemingly unrelated incidents occurred almost simultaneously. A second explosion shook COCHINO resulting in injury to five crew men, and to make matters worse, a furious North Atlantic storm was battering the now surfaced COCHINO when the CO heard the dreaded cry, "Man overboard". Commander Benitez, not fully aware of the extent of conditions below decks, and with full faith and confidence that his XO could handle the below deck emergency, kept his attention on the man on the water. With the help of a crew member who jumped in the water to aid the one washed overboard and a second crew member who stood on the top of the saddle

tanks, CO Benitz maneuvered COCHINO to effect a rescue within five minutes—amazing given the state of the sea.

Meanwhile, XO Wright got word that the short could only be cleared by pulling the battery disconnects located in the battery well in the After Battery compartment. He made the decision to enter the compartment, which was by then fully ablaze, and clear the short circuit at the disconnect panel—a most dangerous if not impossible task given the conditions. He donned the rescue breathing apparatus, checked it out, put on gloves and attempted to open the hatch between the After Battery compartment and the Forward Engine Room. The hatch handles were red hot and burned right through the gloves. Wright did, however, get the hatch open and immediately the engine space was flooded with smoke and acrid fumes. As he was attempting to enter the burning compartment another explosion knocked him back severely burning his arms and legs which were not protected by the rescue breathing apparatus. Badly burned, Wright realized that entry into the After Battery compartment was futile and summoned all the energy he can muster to secure the hatch.

The atmosphere in the Forward Engine Room was now loaded with hydrogen as well as smoke and acrid fumes. The hydrogen in the air mixed with the diesel fuel and caused the engines to run away screaming at a high pitch. They were shut down by two badly burned enginemen cutting off the fuel supply, and the compartment was evacuated as it also was then ablaze. All in the fire fighting party were also burned and they were ushered back to the After Torpedo Room for treatment. XO Wright was so badly burned he was not expected to live.

Disaster begats disaster. COCHINO then lost all auxiliary power and engines #3 and #4 in the After Engine Room shut down. All propulsion was lost and COCHINO foundered in the rough seas. TUSK in the meantime had sent over a line which was used to ferry a small unmanned life raft with medical supplies. Communication was by semaphore flags. Two of COCHINO's crew manned the life raft and returned to TUSK to brief her CO as to the extent of the problems, including the possibility of abandoning ship. A series of gigantic waves hit TUSK and washed

12 men overboard—11 of TUSK's crew and one of the COCHINO messengers. TUSK pulled away to initiate rescue operational procedures. COCHINO was unaware of the situation. In two hours of maneuvering in a wind blown tossing sea, Commander Robert Worthington, CO of TUSK, was able to locate and save only five of the men in the water. He made the decision to abandon the effort to save the remaining men in the water realizing they had probably drowned and turned his attention back to aiding COCHINO. The time was then 1350.

A turn for the better happened when the electricians restored auxiliary power. The enginemen were successful in restarting the After Engine Room diesels. COCHINO now has propulsion and steerage albeit the rudder is being manually controlled from the After Torpedo Room. Their position was then about 200 nautical miles from the coast of Norway to which they headed, slowly. TUSK reappeared and led COCHINO in pursuit of safe harbor in a Norwegian port or fjord. Of the 60 men topside on COCHINO, 47 were lashed to the superstructure with no protection from the weather. The other 13 were inside the protective shield of the sail. CO Benitez ordered the 47 to *stuff* themselves into the confines of the sail literally like sardines in a can to offer some protection from the arctic cold. The time was then 1528.

Five hours later at 2039, COCHINO's fortunes took a turn for the worse. An explosion rocked the After Engine Room—probably from hydrogen leaking through the sealed off ventilation or engine exhaust systems. Benitez on the bridge got word that the After Engine Room was on fire, was filled with gas and had been abandoned. All hands aft were now in the Maneuvering Room or After Torpedo Room. TUSK, a mile ahead, is notified by a signalman using semaphore and reversed course. Visibility was no problem as this was *the land of the midnight sun*.

The stern was settling and water was washing over the After Torpedo Room hatch—the only way out for the crew. CO Benitez ordered all hands topside—no response came from the After Torpedo Room on the sound powered phones. Wasting no time 19 year old Quartermaster Willard Whitman on the bridge shed his sound powered phones, jumped from the bridge, raced aft through

the perilous waves washing over the slippery steel deck and opened the After Torpedo Room hatch. By 2155 all hands were topside except the hospital corpsman and XO Wright. Whitman was standing by at the hatch and TUSK was along side to affect a rescue. The corpsman helped the badly burned Wright to the ladder. Wright, with the morphine wearing off and in great pain, tried to ascend. He asked the Lord for help knowing he couldn't pull himself up the ladder with the muscles in his hands and legs all burned. The corpsman could not possibly push Wright's dead weight high enough and Wright could not possibly pull himself up the ladder in his badly burned condition when all of a sudden Whitman was grabbing him under the arm pits and pulling him clear.

Grabbing hold of the lifeline, Whitman then helped Wright navigate the treacherous, slippery deck 200 feet to the superstructure area where a plank had been placed between TUSK and COCHINO which had been tied together with mooring lines. None of the COCHINO crew had crossed over to TUSK yet. The plank was slippery, the boats were bobbing like corks in the churning surf, and if one fell he would most likely be crushed between the hulls of two submarines.

Upon seeing Wright and Whitman approaching, the crew gave them a cheer of encouragement. Wright, not known for wasting time, assessed the situation, stepped on the plank, waited for the two boats to be level and staggered across the plank on his own. The rest of the crew followed one at a time as COCHINO continued to take on water aft and settle by the stern. At 2229 CO Benitez was the last man over the plank. TUSK crewmen cut the last of the taut mooring lines, COCHINO's bow rose and she slipped under water for the final time. She came to rest on the ocean floor 900 feet below the surface at 71° 35' North and 23º 35' East – 70 miles NNE from Hammerfest, Norway and safety.

EPILOGUE: Quartermaster Willard Whitman was credited with saving the life of Executive Officer Lt. Cmdr. Richard M. Wright. He was presented with a Letter of Commendation and Commendation Medal from the Secretary of Navy on 26 May

1950 for his "outstanding performance of duty" while serving on board USS COCHINO SS-345 as related above.

Willard Seth Whitman, born 18 March 1930 in Hibbing, MN, graduated from Hibbing High School, class of '48, enlisted in the US Navy 16 June 1948, graduated from Great Lakes Naval Training Center (Boot Camp) September 1948 and later Basic Submarine School 17 December 1948 and was then assigned to one of the finest and most modern submarines, USS COCHINO SS-345. Discharged from the Navy 05 June 1952, he settled in the St. Louis, MO area where he went on eternal patrol 16 August 1997.

Sailor, rest your oar – no one could have asked for a finer shipmate with whom to sail.

AUTHOR's Note: Whitman and I grew up in the same neighborhood together – a block apart. He had to walk past my house on the way to school or downtown, and he always waved and said, "Hi", to us younger kids. Five years after he joined the Navy, I followed in his footsteps. After completing Boot Camp at Great Lakes and Electronics Technician School at Treasure Island, I volunteered for Submarine duty. 40 of us graduates volunteered for 4 open billets. During the interview process, I used Whitman as a reference. The three interviewers, a white hat, a chief and a lieutenant – all submariners, knew about COCHINO – I got one of the 4 billets. I never had a chance to thank Whitman as our paths never crossed again. This article then is my way of completing that *unfinished business* feeling. Thanks Willard.

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THE SUBMARINE REVIEW

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

Articles for this publication will be accepted on any subject closely related to submarine matters. Their length should be a maximum of about 2500 words. The League prepares **REVIEW** copy for publication using Word. If possible to do so, accompanying a submission with a CD is of significant assistance in that process. Editing of articles for clarity may be necessary, since important ideas should be readily understood by the readers of the **REVIEW**.

A stipend of up to $200.00 will be paid for each major article published. **Articles accepted for publication in the REVIEW become the property of the Naval Submarine League**. The views expressed by the authors are their own and are not to be construed to be those of the Naval Submarine League.

Comments on articles and brief discussion items are welcomed to make **THE SUBMARINE REVIEW** a dynamic reflection of the League's interest in submarines.

Articles should be submitted to the Editor, SUBMARINE REVIEW, 5025D Backlick Road, Annandale, VA 22003-6044.

AMI HOT NEWS FROM AROUND THE WORLD

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NAVAL MARKET FORECAST NEWSLETTER

From the April 2014 Issue

EGYPT

Submarine and Corvette Procurements

Type 209 Submarine: In early March 2014, AMI received information that the EN was considering the procurement of two additional Type 209 submarines from ThyssenKrupp Marine Systems (TKMS) of Germany. This follows the order of two Type 209s in late 2012 for an estimated US $1.26B.

The original contract included options for two additional units and sources indicate that the EN is considering those options at this time. AMI estimated in 2012 that the EN would consider the two additional units as the sea service needed to replace four 50s vintage Improved Romeo class submarines (although had major US upgrades) that were transferred from China in the early 1980s.

The first two units ordered in 2012 are scheduled for delivery in 2016. AMI estimates that the options will probably be exercised in 2015 with construction beginning on units three and four in 2016 with delivery in 2019 and 2020. In regards to funding, it is possible that the EN could use some of the US$20B in aid promised by the Saudi Arabian Government in 2013. It appears that some of that aid will also be used in the purchase of up to four French Gowind class corvettes.

ALGERIA

Additional Submarines to be Ordered in 2014

In early March 2014, AMI received information that the Algerian National Navy (ANN) intended to order two additional Kilo class (636M) submarines by the end of 2014. The estimated US$1.2B covers the construction of both units at Admiralty

Shipyard in St. Petersburg, Russia. Both will be delivered to the ANN by the close of 2018.

This will be the fifth and sixth Kilo hulls for the ANN, which procured two of the 636M variants in 2006 and two of the 877EKM variants in the 1980s. The 636M units were delivered to the sea service in March and July of 2010. The 877EKM variants completed a mid-life refit in Russia by 1996 extending their service lives until 2018 at which time they will be replaced by the two 636Ms that are now being ordered.

With the ANN now involved in a large naval expansion that includes two classes of frigates and amphibious ships, the sea service may wish to continue the expansion of its undersea service as well. Upon delivery of the two submarines in 2018, the ANN could possibly order two additional units in order to maintain a six unit Submarine Force. Although the ANN has begun a transition away from Russia in filling its naval needs, the sea service is apparently satisfied with the Kilo submarines.

ASIA REGIONAL UPDATE

VIETNAM: Kilo Class (636) Class Submarine: On 28 March 2014, the fourth Kilo class submarine for the Vietnamese People's Navy (VPN), DA NANG (HQ-185), was launched from Russia's Admiralty Shipyard in St. Petersburg. DA NANG is scheduled to be delivered to Vietnam by the end of 2015.

MODERNIZATION & SHIP TRANSFER NEWSLETTER

SPAIN – Galerna Class Submarine SPS Tramontana (S 74): In late 2013, the Spanish Navy (SN) Galerna class submarine, SPS TRAMONTANA (S 74), entered dry dock for its service life extension program. TRAMONTANA follows the SPS MISTRAL (S73), which was refloated after its dry dock period in April 2013. The Galerna class is being extended until the S80 (Isaac Perol Class) submarines begin entering service later in the decade.

The service life extension will essentially allow the Galerna class to operate until the mid-2020s. In mid-2013, the Spanish Ministry of Defence (MoD) allocated US$38M to refit the TRAMONTANA. The life extension program will likely include:

- Hull maintenance, repair and preservation.
- Overhaul of main engines, alternators and shafting
- Replace main batteries.
- Software upgrades weapon control system.
- Software upgrades in surfaced search radar and ESM sensors.
- Software updates to sonar suite.

TRAMONTANA will complete its overhaul by 2015 and will be able to remain in service until 2024 although it can be retired earlier if replaced by an S80 before that time.

RUSSIA – Lada Class Submarine SAINT PETERSBURG (B585): In early March 2014, AMI received information that the Russian Navy (RVF) was planning to modify its only operational Lada class submarine, RFS SAINT PETERSBURG. SAINT PETERSBURG is set to receive an Air Independent Propulsion (AIP) system now under development in Russia. SAINT PETERSBURG will be the test platform for a new class of AIP submarines that will begin in 2018. The new submarines are the Fifth Generation (5G) Diesel Electric Submarines now identified as the Kalina class.

SAINT PETERSBURG will probably enter dry-dock by the end of 2014 in order to meet the 2016 installation schedule as announced by the RVF. Following installation, the AIP-equipped SAINT PETERSBURG will undergo testing for a one-year period prior to AIP production beginning in 2017 in order to have the first AIP unit ready for installation on the first Kalina class submarine.

USED SHIP TRANSFER/RECEIPTS/ DECOMMISSIONINGS

INDONESIA – Kilo Class (Type 877/636) Diesel Electric Submarines: On 12 March 2014, Indonesian Navy (TNI-AL) Chief of Staff Admiral Marsetio announced that the sea service

would forego any purchase of used Kilo class submarines from Russia. The Admiral stated that due to the poor material condition of the Russian Navy (VMFR) Kilos, the sea service would discontinue any consideration of used Russian submarines in favor of building new construction submarines in Indonesia.

The Admiral is referring to the South Korean Type 209s that will be built in South Korea and Indonesia. Upon completion of the first three units (unit 3 in Indonesia), the TNI-AL intends to build follow on units in Indonesia in order to realize its future Submarine Force.

The announcement follows the January 2014 visit to Russia to discuss the offer. Talks were to include new construction Kilos (probably the Kilo 636.3 variant) and used units of the 877 and 636 variants. AMI also believes that the TNI-AL will forego any procurement of new Kilos as evidenced by the Chief of Naval Staff's comments concerning indigenous construction of Type 209s. Simply put, new construction submarines from Russia would interfere with Indonesia's long term plans to become more self sufficient in naval construction.

UNITED STATES – Los Angeles Class Nuclear Powered Attack Submarine (SSN) USS MIAMI (SSN 755): On 28 March 2014, USS MIAMI (SSN 755) was decommissioned at Portsmouth Naval Shipyard in Maine. In early August 2013, the USN announced that it would decommission the Los Angeles class submarine USS MIAMI (SSN 755) due to a fire on 23 May 2013. MIAMI was expected to be refurbished, however, by early August 2013, the USN decided to forego the US$450M repair and to decommission and scrap the submarine.

From the June 2014 Issue

INTERNATIONAL-Combat, Sensor and Integration System Developments

AMI is currently tracking combat, sensor and integration systems developments. The following are the highlights for the months of May and June 2014:

Northrop Grumman: In May 2014, Northrop Grumman Corporation was awarded a contract by General Dynamics Electric Boat to complete the detailed design and subsequent manufacturing, assembly, qualification, and delivery of the first turbine generator units for the Ohio Replacement Program (ORP), the US Navy's (USN) future nuclear-powered ballistic missile submarine (SSBN-X).

The turbine units will provide all the propulsion and other electrical power for the new SSBN. The SSBN-X will incorporate an all-electric drive engineering plant that is unlike the steam turbine drives that are used in the current SSBN fleet.

The ORP will consist of 12 units that, under current planning, will begin construction in 2021 and commission all units from 2026 through 2041.

Various Did You Know?

UNITED KINGDOM-On 17 May 2014, the Royal Navy's (RN) third Astute class nuclear powered fast attack submarine (SSN), HMS ARTFUL, was launched at BAE Systems Devonshire Dock Hall in Barrow-in Furness.

NAVAL MARKET FORECAST NEWSLETTER ADDENDUM 1

SWEDEN – MARKET INTEL HOT NEWS – June 2014 Addendum – SAAB Receives Order for Gotland Submarine Mid-Life Refit and Longer Term A-26 Replacement Submarine

On 09 June 2014, AMI received information that SAAB received orders from the Swedish Defence Materiel Administration (Forsvarets Meterielverk – FMV) regarding construction and production plans for the next generation A26 class submarines and the mid-life refit of the two Gotland-class submarines. The first order for the 2014-2015 timeframe is valued at MSEK 467 (US$70M) and represents the beginning of the Gotland refits, now several years behind schedule.

The refits will more than likely begin immediately with the first unit returning to service in 2016 and the second in 2017.

In regards to the A26 Class Submarine Program, SAAB and FMV signed a Letter of Intent (LoI) regarding the Swedish Armed Forces' underwater capability from 2015 through 2024. This capability refers to the design and construction phase for the A26 submarine worth an estimated SEK 11.2B (US$1.7B). The program currently calls for the acquisition of five hulls with the first beginning as early as 2016.

These agreements in essence shift the Gotland mid-life refit and their A26 new construction replacements from Kockums (now named ThyssenKrupp Marine Systems AB and owned by ThyssenKrupp Industrial Solutions – TKIS) to SAAB as the primary contractor/supplier, a clear sign that Sweden has restructured its submarine and underwater technology industry. TKMS AB, the projected builder (under SAAB contract) of the A26 and the Gotland refits, is currently owned by TKIS of German and will more than likely be purchased by SAAB in the short term with the Swedish Government also actively increasing its share in the company.

MODERNIZATION & SHIP TRANSFER NEWSLETTER

ISRAEL-Dolphin Class Submarine Leviathan: In May 2014, AMI received information that the Israeli Navy (Heil Hayam Ha Yisraeli (HHHY)) was performing a mid-life upgrade on the Dolphin class Submarine Leviathan under a US$43M contract. The upgrades include:

- Hull, mechanical and electrical (H,M&E) work including overhaul of the three MTU 16V 396 TE84 diesel engines.
- Software upgrades to the Atlas Elektronik ISUS 90-1 combat management system (CMS).
- Software upgrades to the CSU-90, PRS-3 and FAS-3 sonar suite.
- Upgrades to the navigation and communications systems.
- Installation of the Rafael Torbuster anti-torpedo decoy.

The overhaul is being conducted at Haifa Shipyards in Israel and expected to last through 2015.

USED SHIP TRANSFERS/RECEIPTS/ DEOMMISSIONINGS

BANGLADESH Ming Class (Type 035G) Diesel Electric Submarines: On 06 December 2013, AMI received information that the Bangladesh Navy (BN) ordered two submarines from China, probably of the Ming class (Type 035G). The deal was worth a reported US$203.5M, which includes an overhaul and crew familiarization prior to transfer. The BN will make payments through 2017 with delivery originally scheduled for 2019.

However, in May 2014, AMI received information that the People's Liberation Army Navy (PLAN) recently decommissioned two units of the Ming class. A Chinese spokesman indicated that these two units would be transferred to the BN in 2015. Apparently the BN moved up the delivery schedule as its neighbor Myanmar is also attempting to develop a Submarine Force. The BN has been training submarine crews on and off in Pakistan and China since 2010.

Previous information received over the past 12 months indicated that possibly the Type 039 Song class was being considered. However, the Songs are still in service with the PLAN and would undoubtedly cost well over US$100M per unit. The Ming class, built in the 1970s and now being decommissioned from the PLAN are more of a fit for the BN as it attempts its first foray into the undersea domain.

The procurement of submarines is part of the three dimensional naval force consisting of air, surface and subsurface units announced by the Minister of Defense in 2009. The procurement of the Ming class boats is probably also the first step in the development of the BN's undersea service although it will be many more years before the BN can afford more modern used or new construction submarines.

From the July 2014 Issue

MODERNIZATION & SHIP TRANSFER NEWSLETTER

ARGENTINA – Santa Cruz (TR1700) Class Submarine Santa Cruz (S41): In late June 2014, AMI received information that the Santa Cruz class submarine SANTA CRUZ (S41) arrived at Argentina's CINAR State Shipyard to begin its life extension.

Work package includes:

- Four diesel engines and electric motor will be replaced.
- Batteries will be replaced.
- Mast will be replaced.
- Hull resurfacing (in drydock).
- Limited software modifications to the combat management system (CMS) and combat systems.

The SANTA CRUZ will be completed by 2017 extending its service life until around 2030. SAN JUAN (S42) completed its refit in 2012.

2013 NAVAL SUBMARINE LEAGUE ANNUAL SYMPOSIUM

DISTINGUISHED SUBMARINER

VADM EDWARD "AL" BURKHALTER, USN, RET.

Adm Mies, fellow Submariners, and friends,

I am indeed honored, and humbled, to be recognized alongside so many of our distinguished colleagues. And I am especially honored to be in the company of one of our best, ADM Frank Kelso.

Becky and I have many of our family here tonight. Two of our sons served in the Navy; one son was a member of the clandestine service, and all three of them served in Iraq or Afghanistan. Two of our daughters married naval officers, while one granddaughter graduated from the Naval Academy and served as a surface warfare officer.

We are especially pleased tonight that a grandson, Machinist's Mate First Class (SS) Patrick Smith, could join us. He is serving in the Gold Crew of USS WYOMING. I would also like to recognize two shipmates and long time friends who are here tonight: Dave Cooper and Mimi; and Sam Ward and Sue.

I just want to make a few key remarks. First, I want to reemphasize what you have heard several times today and what you have heard from myself and others these past couple of years. With the Virginia Class submarine we are building the most capable and deadly attack boats in the world. We have gained a sterling reputation for delivering these submarines early and within or under budget. I congratulate each of you—Navy leadership, shipbuilders, and key contractors—for your dedication and hard work to achieve these goals. We are recognized as the foremost successful program in the entire Defense Department. But I want to remind all of you once again: DON'T rest on your oars or let success become complacency. As RADM Dave Johnson has reminded us: KEEP AND RETAIN YOUR SHARP EDGE.

Second, I want to congratulate each of you who are serving, or have served, in our Submarine Force, the finest group of officers and men—and now women—in the Navy. Tom Clancy, who recently passed away, echoed this praise on many occasions and said, "there are none better". And let me recognize one other group: our wives and girlfriends who have stood beside us, taken care of family when we were deployed, and greeted us warmly when we returned. They are an integral part of our success, and we salute you.

Finally, NEVER FORGET OUR HERITAGE. We have worked long and hard to attain it. It is incumbent upon each of us to insure it is instilled in our successors.

Thank you again. God Bless our Force and God Bless America.

ETERNAL PATROL

CAPT Frank Arland Andrews, USN, Ret.
TMSN (SS) Robert "Dex" Armstrong, USN, Ret.
Mr. Robert "Bob" A. Hamilton
CDR Thomas E. Poole, USN, Ret.
ADM Charles R. Larson, USN, Ret.
Mr. Richard D. Llewllyn
CAPT Dave Middleton, USN, Ret.
RADM John Brad Mooney, USN, Ret.
Mr. Joseph F. O'Donnell
Rev. Gilbert V. Wilkes III

THE SUBMARINE COMMUNITY

MAGNETISM, MAGNETIC PERSONALITIES AND THE 1958 INTERNATIONAL GEOPHYSICAL YEAR

by RADM Dave Oliver, USN, Ret.

Editor's Note: Earlier this year the Naval Submarine League received the following request: "We are a Swiss watch brand and we are hosting a product launch here in New York for bloggers and journalists who focus on watches. The particular focus of the product launch is on naval history, specifically the 1958 Geophysical year of exploration. We would be delighted if someone from your organization could speak about the USS Nautilus and its amazing journey. Here's an excerpt from our Press release which might help you better understand the focus on the product and why it's important to us: On August 1st 1958, the first ever atomic submersible vessel, named USS NAUTILUS in tribute to the fantastic submarine imagined by Jules Verne in his novel 20,000 Leagues Under the Sea, set off in absolute secrecy with the unprecedented objective of making a submerged transit from one ocean to the other via the most direct route – meaning beneath the ice sheet covering the Arctic. Nonetheless, this crossing involved countless dangers, since the ice deep below the water was full of jagged edges that rendered the enterprise extremely perilous. Moreover, watches and compasses tended to become completely unreliable and begin behaving erratically upon nearing the poles. After three days in submersion, the NAUTILUS made the transit without anyone apart from the crew being aware of this feat. Moreover, the submarine remained cut off from the world during its journey under the ice that lasted a grueling five days. After being decorated by President Eisenhower, Captain Anderson was also delighted to

receive an additional gift from the authorities of Canton Geneva in the form of a Geophysic chronometer. Please let me know if you or anyone from your organization would be willing to come speak to our small group"

RADM Dave Oliver accepted the invitation on behalf of the League and gave the following talk.

Let me quickly sketch some background in the event there are a few of you who were not blogging in the 1950's. I will try to keep this to 144 characters… or so.

If you recall, during World War II, Stalin suspected that the United States and England had delayed coming to Russia's aid until Germany had bloodied itself trying to take Moscow. Consequently, Stalin erected an iron curtain of border states and divided Germany to prevent that situation from ever happening again. Those border states were to the West and South of Russia. To protect Russia on the North and East, Stalin relied upon pack ice and his hundreds of diesel submarines.

My short précis of physics involves how submarines used to navigate at sea. There was no GPS until well into the seventies and satellites weren't reliable until even later. Therefore, to navigate underwater we relied upon gyrocompasses and stabilized them through feedback of magnetic compasses corrected for where magnetic North actually was. This works, as long as you are not close to the actual North Pole, because as all of you experts probably know, magnetic north moves, propelled by the bombardment of solar rays, in a rough daily ellipse nearly fifty miles in diameter, and has moved laterally more than a thousand kilometers during the last century, so if you operate near the Pole magnetism is a no-no.

Okay, physics and geography lesson complete, let's go back to the 1950's and larger-than-life personalities.

In 1950, with the advances in rocketry, radar, and computing, several world scientists had suggested having a worldwide Geophysical Year in the eighteen months between July 1957 and December 1958.

Unfortunately for the United States, in 1955, the President's Press Secretary, James Hagerty, had announced "that the United States intended to launch "small Earth circling satellites" as part of the United States contribution to the International Geophysical Year." This was not to be, as the Navy, which was responsible for launching these satellites, was unable to get them off the ground.

But, the Navy was not the only Service to perform poorly that year, for in March, the Air Force accidentally dropped an atomic bomb on Mars Bluff, South Carolina. President Eisenhower and the people of Mars Bluff were fortunate that nuclear fission wasn't triggered but several people were injured by the conventional explosives.

A month later unemployment in Detroit reached 20% and shortly thereafter Governor Faubus decided to resist integrating the public schools in Little Rock. President Eisenhower, the former Five Star Commanding General of the Army, was forced to nationalize the Arkansas Guard and send Army troops to patrol the high schools.

The day after the Soviet Union launched Sputnik, as Commander Anderson, the Commanding Officer of USS NAUTILUS (SSN 571), later said in his book about traveling under the North Pole, "in Little Rock, for the first time in days, there was no headline on the front pages of the morning Arkansas Gazette or the Evening Arkansas Democrat newspapers about the tumultuous events surrounding the integration of the city's Central High School and President Eisenhower's (Army troop led) efforts toward that end. That story was replaced with the news of the Soviet Union's Sputnik launch."

To answer the Soviet technical challenge, President Eisenhower, at the urging of his senior naval aviator aide, who happened to be a personal friend of that same Commander Bill Anderson, decided that if Nautilus did a crossing under the North Pole, it would distract the world from the Soviets' achievements (and various US failures), and emphasize that the Soviet Union did not have any nuclear submarines.

Both Anderson and Eisenhower's senior naval aide, Pete Aurand, would wait to inform anyone in the Pentagon about the

proposed North Pole passage until after the President was committed to the mission. Admiral Rickover, who was the father of nuclear submarines, and was in charge of both nuclear safety and had been Commander Anderson's boss, would be even more of an afterthought.

President Eisenhower and his press secretary, James Hagerty, quickly perceived that this North Pole mission had the potential to swiftly make the United States appear technologically as well as militarily superior to the Soviet Union. Equally importantly to Eisenhower, there was no extra cost. The United States Navy had already set aside money for a nuclear submarine building program. Therefore highlighting a nuclear submarine success did not have the downside of implicitly endorsing a budget-busting space effort to catch up with the Soviets. Controlling military spending was consistent with President Eisenhower's domestic and military priorities, and Nautilus was a perfect asymmetric answer to Sputnik.

The President knew his political stakes were high. If the mission failed, he did not want it known. There had been enough US failures lately. On the other hand he wanted to exploit full credit for any success and accordingly insisted on controlling the timing of any and all announcements. He was clear that the concept and mission were to be treated as Top Secret.

With the Nautilus's successful passage under the ice cap in the summer of 1958, the political gamble had paid off, and the President announced the successful completion of the mission in the White House on August 18, 1958 (a ceremony to which Admiral Rickover was not invited).

As Commander Anderson (later to become Congressman Anderson from 6th District of Tennessee) wrote of the White House ceremony –

"I pointedly avoided talking about the strategic military impact of our transit beneath the ice. But it was obvious that Nautilus's feat had immediately changed things in that regard."

Time Magazine made that point as well.

"In one voyage of one U.S. nuclear submarine…the Navy had…increased the power of the U.S. deterrent by laying bare the Communist empire's northern shores to the future Polaris-missile-toting nuclear submarines…"

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NAVAL SUBMARINE LEAGUE CORPORATE MEMBERS

Thirty Years or More

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The Babcock & Wilcox Company★★★★★
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CORPORATE DUES

★★★★★ = 5 Star Level (10,000+)
★★★★ = 4 Star Level ($7,500+)
★★★ = 3 Star Level ($5,000 +)
★★ = 2 Star Level ($2,500 +)
★ = 1 Star Level ($1,000+)

Naval Submarine League
5025D Backlick Road
Annandale, VA 22003
Tel: 703-256-0891 • Fax: 703-642-5815
E-mail: subleague@navalsubleague.com

"The Second Hundred Yea

MEMBERSHIP APPLICATION FORM

Name: _____ Birth Year: _____

Rank/Rate, Service (if applicable): _____

Duty Station (if applicable): _____

Preferred Mailing Address: _____

_____

Telephone Number (H/O/C): _____
Circle one

E-mail (Home):_____ (Office):_____

THIS SECTION MUST BE COMPLETED BEFORE YOUR APPLICTION WILL BE PROCESSED

I hereby apply for membership in THE NAVAL SUBMARINE LEAGUE. I certify that I am a citizen of the United States or a citizen of _____. I also certify (check one) that _____ I do not or _____ I do act as an agent, representative, employee (includes active duty military), or in any other capacity, at the order request or under the direction or control of the government of a foreign country or a foreign political party. If "I do" is checked above, a brief description of the foreign affiliation must be provided with the application.

Signature:_____

NAVAL SUBMARINE LEAGUE MEMBERSHIP APPLICATION

ELECTRONIC *REVIEW* MEMBERSHIP

The following Membership levels include only the electronic version of The Submarine Review.
Please check the applicable membership level:

☐ Active Duty E1-E3 or Officer Student (e.g., USNA, NROTC, SOBC, NPS, NPTU) Initial: Free for 2 years

☐ Active E4-E6/01-03 3 Years $15.00 ☐ Active, Reserve, Ret., Civilian E7-E9/O4-O10 3 Years $30.00

OR LIFE MEMBERSHIP with electronic version of *The Submarine Review*. *(Life membership may be paid in 5 equal installments)*

☐ Age 39 and younger $250.00 ☐ Age 40-59 $200.00 ☐ Age 60+ $150.00

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Please check the applicable membership level:

REGULAR MEMBERSHIP* ☐ $35.00 For 1 Year ☐ $90.00 For 3 Years

**Persons residing outside the United States are required to remit an additional $20.00 PER YEAR for mailing costs.*

OR LIFE MEMBERSHIP *(Life memberships may be paid in 5 equal annual installments)*
☐ Age 39 and younger: $500.00 ☐ Age 40-59: $400 ☐ Age 60 and older: $300.00

PAYMENT

☐ CHECK ☐ VISA/MASTERCARD ☐ I would like to request automatic membership renewal

VISA/MASTERCARD #: _____ Amount to be charged: $ _____

Exp. Date: _____/_____ Security Code: _____

Signature: _____