

# THE SUBMARINE REVIEW



**JUNE 2018**

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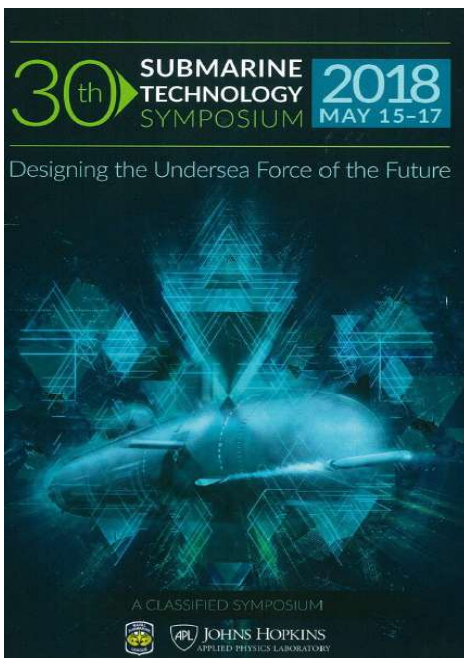
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***FROM THE PRESIDENT***

I recently returned from the 30th annual Submarine Technology Symposium (STS) which is jointly hosted by the Naval Submarine League and Johns Hopkins University Applied Physics Laboratory. The secret level symposium was extremely successful this year with record breaking attendance. Much of the credit for the popularity of this event goes to the quality of the presentations and the leadership of the session chairs and the STS executive committee. The Symposium General Chair, VADM Michael Connor, USN (Ret.), Symposium Co-Chair, Ms. Lisa Blodgett and



Symposium Program Chair, Ms Misty Hechinger deserve special recognition for their leadership and hard work. The entire staff of the Submarine League is also to be commended for the flawless execution of the event. The proceeds from STS help fund the publishing costs of this magazine and many of the other activities of the League.

Although the majority of the presentations at the Submarine Technology Symposium are classified, some of the keynote presentations are done at the unclassified level. Where possible, we obtain copies of the unclassified presentations for *The Submarine Review*. We will include the remarks made by Mr. Ron O'Rourke, Naval Analyst at the Congressional Research Office in the next issue.

Finally, I would like to thank each member of the Naval Submarine League who is reading this for your support. If you are not a member of the League, please join us by going to our recently upgraded web site at [www.navalsubleague.org](http://www.navalsubleague.org). Membership fees start at as little as \$30 for a

three-year membership. Students are eligible for a free one-year membership. Active duty submariners both enlisted and officers are most welcome as members.

John Jay Donnelly  
**President**  
[President@navalsubleague.org](mailto:President@navalsubleague.org)

### **NOTES FROM NSL HEADQUARTERS**

#### **WE'RE MOVING!**

The NSL is moving our headquarters June 16th! The new address is 1737 King Street, Suite 600, Alexandria, VA 22314. Our phone number will stay the same.

#### **NSL UPDATES**

This email from the Executive Director is sent to all members every two weeks. If you have not been receiving the NSL UPDATE email, please contact us at 703-256-0891!

#### **ATTENTION STUDENT MEMBERS**

Students who are graduating and currently use a school email address should contact the NSL at 703-256-0891 or email [members@navalsubleague.org](mailto:members@navalsubleague.org) with your new information and your graduation date.

#### **ATTENTION ACTIVE DUTY MEMBERS**

Active duty should let the NSL know about any changes in address, email, phone or military status.

#### **VIEW *THE REVIEW* PAGES IN COLOR!**

The print version of *The Submarine Review* is primarily in black and white. To see all the article graphics and slides in color and to be able to enlarge pictures and captions, view them on our website. Go to the Member's Only section, log in with your member ID, and select *The Submarine Review* on the right-hand side of the screen.



**EDITOR'S NOTES**

I begin this note by recognizing the 50th anniversary of the loss of USS *Scorpion* and the 55th anniversary of the loss of the *Thresher*. This issue includes articles addressing each of these tragic events, submitted by Submarine League members and former submariners. Please give these articles your appropriate attention and help pass on the lessons offered by the authors to current and future submariners.

Our Naval Submarine League continues to rack up more successful events. This spring we hosted the Corporate Member Days in March and then in May, the NSL sponsored the 30th annual Submarine Technology Symposium that was hosted by Johns Hopkins APL. Along with the Annual Symposium, these events provide a wealth of information that we enjoy sharing with our membership in this journal, to the extent that we have access to the briefings and security guidelines allow.

In this issue we have four transcripts from the 2017 Annual Symposium. We also are including highlights from the Corporate Member Days including the remarks of U.S. Representative Derek Kilmer of the great state of Washington. A new feature in this issue is an interview with the CEO, Ms. Star Dillard, of one of our corporate members, CEPEDA Associates, Inc.

I mentioned the Technology Symposium (SUBTECH), I would be remiss not to recognize the significant contributions of everyone who helped make it such a success, including the new NSL Chair, VADM Mike Connor and his extremely capable and experienced co-chair, Lisa Blodgett and so many others too numerous to name here. We hope to have two of the unclassified presentations given by our speakers for our next issue.

We have three other articles in this issue that call upon 20th century submarine experience to trigger critical thought on our part. The first is an essay by Capt Michael Junge on the subject of submarine skippers in WWII. The second is an essay by Norman Polmar on the Russian submarine force levels in the 20th century, our interpretation of the Russians' intent and his suggestions as to some lessons we should take away from that recent history. Third is a historical rendition by Dr. Bill Browning

of the Submarine Force tactical analysis efforts as begun in WWII and carried over through the deactivation of COMSUBDEVRON TWELVE in 2016.

Finally, last, but certainly not least, we have a challenge from RADM Jerry Holland (no surprise). He has given us an article on the nuclear deterrent TRIAD in which he provides historical context, brings us to the current Nuclear Posture Review and then challenges the Navy to do the right thing in support of submarine strategic deterrence capability. You've got to read this to get his full argument.

Enjoy this issue, it is packed with good stuff. Thank you for your contributions and keep the mail coming...

Good Hunting!  
Mike Hewitt  
Editor@navalsubleague.org

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**Wednesday 7 March 2018**

GENERAL SESSION

- 1800 Welcome Remarks  
**ADM Kirk Donald, USN, Ret., NSL Chairman**
- 1805 Remarks  
**ADM Frank Caldwell, USN, Director, Naval Reactors**
- 1900-2200 Networking Reception

**Thursday 8 March 2018**

BREAKFAST

- 0730 Breakfast
- 0800 Introduction  
**ADM Kirk Donald, USN, Ret., NSL Chairman**
- 0805 Congressional Speaker  
**Congressman Derek Kilmer (WA)**

SESSIONS

- 0900 **VADM Joe Tofalo, USN, Commander, Submarine Forces**
- 0940 Presentation of Corporate Member 5, 10, 20, 25, 30, and 35 Year Awards
- 1000 **RADM John Tammen, Jr., USN, Director, Undersea Warfare, CNO N97**
- 1040 Break
- 1055 **RADM David Hahn, USN, Chief of Naval Research**
- 1135 **RADM Michael Jabaley, USN, Program Executive Officer for Submarines**
- 1215 Closing  
**ADM Kirk Donald, USN, Ret., NSL Chairman**



## CORPORATE MEMBER DAYS OVERVIEW

The 2018 Naval Submarine League's Corporate Member Days event, held at the Capital Hilton in Washington, DC on March 7th and 8th, was a testament to the Naval Submarine League's invaluable industry support.

Hundreds of representatives from companies large and small, as well as active duty submariners, climbed the grand staircases and poured into the wide hall of the hotel that buzzed louder and louder with voices making acquaintances and connecting over shared service or shared purpose. People stopped and leaned in to examine every submarine ever built drawn to scale on the *Submarine Evolution* poster on display next to the registration booth (for sale on the NSL website). They flowed into the dramatic, tiered ballrooms for speeches, then good conversations and food.

The Corporate Member Days event serves a dual purpose: to provide our Corporate Members a platform for networking and to celebrate them. This year, we celebrated anniversaries of support from twenty-one companies. A full list of the awardees can be found on the back cover.

2018 was a special celebration of the longevity of our organization, thanks to our founders and all those who have joined since. The cover of the program included a variety of images from our founding year including the first membership card issued, the first *Submarine Review* printed, and pictures of submarines commissioned 35 years ago in 1983.

Admiral Caldwell, Congressman Kilmer, Rear Admiral Hahn, Rear Admiral Jabaley, Rear Admiral Tammen, and Vice Admiral Tofalo delivered presentations throughout the event. Each of the speakers presented a different perspective and offered his expertise, none managed to get away without answering some challenging questions.

Congressman Kilmer emphasized that the most important action we can take, as members of the Naval Submarine League, is to evangelize our message of the importance of investing in the Submarine Force. Rear Admiral Jabaley, after an informative speech, announced his retirement as the Program Executive Officer for Submarines and named his relief, Rear Admiral David Goggins.

Each of the speeches had the same basic message: we need to support the development of our Submarine Force and our Corporate Members are key to guaranteeing the success of our shared goal.

While the first night's speeches were happening, a stranger stopped a staff member in the hall and asked, "How can you be a member of the Naval Submarine League if you've never been on a submarine?"

"We promote the importance of submarines to the national defense," she responded. "You don't have to serve in submarines to think it's important."

Many have served in submarines and many have not; what connects our members and gives them purpose is interest in and support for the Submarine Force.

**NAVAL SUBMARINE LEAGUE  
CORPORATE MEMBERS DAYS**

**UNITED STATES REPRESENTATIVE  
DEREK KILMER (D-WA)**

REP. DEREK KILMER: Thanks, everybody, it's good to be with you. Anyone here from Washington state? Alright, I think one person is here from Washington state, so I'm going to do my best to please him.

I was asked to give you an update on what's going on in Congress. Admittedly, I'm a little reticent to do that since many of you are still eating. Initially I was asked to speak for 25 minutes about what's going on in Congress. I'm not going to do that. I'm going to try to keep it to 10 to 15 so I can take some of your questions. That makes this one of the easier speaking engagements I've had.

I will tell you the hardest speaking engagement I ever had was actually in Washington state, in my district, at South Colby Elementary School. I was their Veteran's Day speaker and the assignment was to speak to pre-school through fifth grade for 20 minutes. I showed up in the gymnasium and it was filled with pre-school through fifth grade -- 20 minutes. I went up to one of the teachers and said, 20 minutes, I'm screwed. She gave me the best advice I have ever gotten in my time in public service. She said, Derek, here's the deal. Say whatever it is you've got to say, say it in whatever amount of time you've got to say it in, but if you see any of the kids start to pick their noses, wrap it up.

(Laughter).

So, I'm going to try to keep it short, but if you feel like I'm running long, you all know what to do. Right up the road from South Colby Elementary School is Naval Base Kitsap in my district. For over 125 years our community has been home to the Navy. In my neck of the woods the Navy isn't just service members. They're our families and they're our friends and they're our neighbors, and it's a bond that goes back decades. You'll see it when you show up at Bangor, you see it when I stand outside the gate at Puget Sound Naval Shipyard and other locations within Naval Base Kitsap.

We love our Navy and we, like all of you, will do all we can for those



who serve. In fact, a couple of years back I did something that I didn't think I was capable of, and that is I spent 36 hours on a submarine, on the USS *Hartford*, as part of the ICEX. I came away really with three takeaways.

First, the Arctic is really cold. It was very, very cold. Second, the people who are able to work and sleep and live on a submarine for weeks on end are genetically different than I am. Third, and this is probably most important, I came away with an appreciation for the fact that no one comes close to matching the power and the capability of the United States Navy.

When it comes to the equipment and the vessels that our sailors operate with, you are a key reason why we own the seas. You build and repair the most complex machines ever devised, and I want to thank you for that. And I want to say that frankly Congress needs to do a better job of having your backs so that you can have the backs of our sailors. That success, that strength, your work, should not be taken for granted.

I have a deep respect for what you do. I worked in economic development professionally before coming to Congress. I grew up in a little timber town on the coast of Washington state and I saw our local economy crash and saw a bunch of my parents' friends lose their jobs. So after going to school I came back home to Washington state and worked in economic development professionally.

We had a sign up on the wall of our office that said, we are competing with everyone, everywhere, every day, forever, which I admit I found kind of intimidating. But I actually think it's a pretty good ethic, not just for folks who work in local economic development. I think it's actually a pretty good ethic for our country, too. And I think it's an ethic that the United States Congress needs to pay better attention to.

Look at our submarine fleet. If Congress doesn't get its act together we are facing a very real shortfall of submarines that could jeopardize our operational requirements into the future. It's a dangerous world out there and we know -- listen, I know the vast majority of you, as evidenced by the show of hands, are from the East Coast. We face a number of threats in the Pacific. The Pacific theater is vast, and we need a sizeable fleet to maintain our footprint in areas where China and Russia and North Korea are looking to spread their influence.

They know that they're in a competition, and Congress needs to figure out that it's in a competition too. We need subs to double down on deterrence. We need the capability that the guided missile submarine provides to project power, and we need the intelligence that the fast attack boats can gather and deliver. And we need to keep our sea lanes open.

That means a few things: delivering the Columbia-class on time; continuing to build the Virginia-class subs; distributing the punch and power of the SSGNs through the Virginia Payload Module. That will get us there. But we need Congress to remain committed and focused on creating the stability and predictability that we need to maintain our world-class submarine fleet, that we need to maintain the industrial base. And none of that will happen unless Congress gets a handle on budgeting and appropriations.

The reality is, the nations with whom we compete, our adversaries around the world, are not sitting still. I can tell you they are not farting around with government shutdowns and sequestration and continuing resolutions and some of the partisan silliness you've seen in this town. Your primary customer, Uncle Sam, has really put you through the wringer, and it has been more than two decades since Congress passed a full slate of appropriations measures on time. Your industry has had to watch Congress enact painful budget cuts through sequestration.

I admit, I had not heard of sequestration until I ran for Congress in 2012. I looked it up. It's a Latin word for stupid. For the life of me -- I was talking outside -- no family would budget this way. No business would budget this way. No one would -- this approach of across the board mindless cutting is just dumb.

More recently, Congress has been so dysfunctional that leadership has resorted to kicking the can and keeping caps on spending levels that were deeply below what's needed as a consequence of sequestration. You've had multiple continuing resolutions. So every time I get on an airplane to fly here the first thing I do is I write my kids a letter. I try to explain to them what I'm going to be doing that week and why I'm leaving them.

If you think about what I've written them since mid-September, more often than not I've written them a letter that starts with, this week

we're going to try to avert a government shutdown. My 11-year-old, Sophie, actually called me on it. She was like, "Dad, what is going on? It feels like every few letters I get the government is about to shut down."

You have seen continuing resolutions from September to November, from November to early December, from early December to late December, from late December to February, and now to March 23rd. That is an idiotic approach to budgeting. I struggle to explain the inexplicable. I can't explain it to my kids and I can't explain it to you.

But I can tell you this, having worked in economic development professionally, my observation is the main thing that industry wants from government is an environment of trust and predictability. In my view, Congress has done a pretty fine job of screwing that up. The secretary of the Navy recently said, kicking the can -- and this is a quote, "It has cost us \$4 billion, that's \$4 billion in cash in a trash can with lighter fuel, burn it." Those were his words.

That had real consequences for the submarine fleet. So Congress simply has to get its act together. Let me talk very quickly about the short-term and the long-term and then I'll take your questions.

The short-term spending bill that passed a few weeks back, that ended the most recent government shutdown, significantly lifted the spending caps, both for defense and non-defense discretionary. I'm hopeful that we'll get a CR hopefully before March 23rd that will produce some real outcomes for the Navy. That's good for all of you, it's good for the Navy, it means jobs for folks back home at Naval Base Kitsap at the naval shipyard.

And I hope that the lifting of the spending caps can bring some predictability and some stability to the budget process, at least for a couple of years so that we have a process that ultimately can lead to building the Columbia-class on time. I hope it means that the \$150 million that is needed to support supplier-based reconstitution is available in fiscal year 2019. I hope it means forward progress on sustained acquisition on Virginia-class subs.

In the short term, I will also add Congress also needs to get a handle on acquisition reform. I was talking with a few folks earlier; the reality is part of the problem is Congress. Congress has consistently tried to solve yesterday's problem by consistently making it more and more difficult

for the Navy to acquire the innovations that you guys make. My hope is that you'll see some improvements, frankly, leveraging some of the successes that we've seen through other acquisition programs, including the Virginia-class subs. We have multi-year contracting where we provide some flexibility to the Navy.

Beyond that, though, Congress needs to fix its budget process over the long haul. I'm going to talk about something that is not particularly sexy and was not news breaking but tucked into the spending bill from a few weeks back was the creation of a new committee, which needs a shorter name. It is called the Joint Select Committee on Budget and Appropriations Process Reform, which super rolls off the tongue.

But it is a committee that is half Democrats and half Republicans, half Senate and half House, and its goal is to try to fix what is an undeniably very broken budget process. I'm going to work hard on that. I think there are clearly some reforms that can provide more certainty, because what is at stake is our national security. In order to build in a way that allows the Navy to compete with our enemies and with hostile nations around the world, it needs Congress to give it the confidence that the money is actually going to be there.

I guess I'll end with just a quick story. Probably one of the coolest things I've gotten to do in this job is when I get to either go out on a submarine or meet with folks at Naval Base Kitsap. I got to attend the change of command for the USS *Jimmy Carter*, and it was awesome meeting the sailors who were there. I will also tell you I was somewhat stunned, because when I arrived the legislative liaison said, would you like to meet the president?

I was like, the president is here? President Carter was here, and he had shown up unannounced for the change of command, which I guess if you're Jimmy Carter you just do that. It was pretty amazing.

He told a story that got everyone on the edge of their seats. He told the story of his entrance into the nuclear force. He talked about interviewing with Admiral Rickover, which was an amazing story and caused me to go read books about Admiral Rickover and watch what was an okay documentary on Admiral Rickover.

He talked about being brought into the office and having to answer questions for hours about everything from naval history to naval tactics

to all sorts of topics, including American history, music and other things. As President Carter explained it, he was asked, how did you do at the academy? He said, I stood up and said I was number 72 out of however many.

Admiral Rickover said, that's pretty good, would you say you did your best? President Carter said, I had this pang of guilt all of a sudden. I had spent a lot of time hanging out with friends and I did pleasure reading and things like that. He said, no sir, I did not do my best.

As he explained it, Admiral Rickover turned his chair around and had his back to him. Carter said, I just sat there, and he never turned back around. He said, I sort of slinked out of the office and went home to Rosslyn and said, gosh it had gone so well and then I kind of blew it at the end. He said, two weeks later I got a letter saying that I had been admitted into the nuclear force. He said, I was so struck by my interaction with Rickover that it really altered how I approached everything from there.

Then he gave what I thought was the coolest kudo to the story. He said, I was in my post-presidency and I got notified that they were going to name a ship the USS *Jimmy Carter*. They said, I got to provide the Latin motto for the ship. He said, the Latin motto for the USS *Jimmy Carter* is *semper optima*, always the best. All the sailors were like, that is so cool. That was the genesis of the Latin motto.

I will tell you, it is safe to say that the crew of the USS *Jimmy Carter* is absolutely doing their best. We know that on September 11th the Navy released a photo of that ship coming into Hood Canal on its way back to Kitsap with the Jolly Roger flag posted, indicating a successful mission. Maybe if Congress got to fly the Jolly Roger flag when it did something good, maybe that would help, I don't know.

But listen, we need to get more things done in Washington, D.C., because what you do matters. It matters to my two little girls who need to grow up in a safer and more secure world. It matters to the sailors I represent and their families. It matters to the security of our country and our allies around the world. It matters to you and your companies and to the jobs of the people who depend on you.

Every one of you has the capacity to get the attention of members of Congress, of House and Senate members, and to tell them that Congress



needs to fix this, that we cannot have policies like sequestration. We cannot keep kicking the can with these continuing resolutions. Your presence here today is an indication that you're already willing to do your best to do that hard work. So thank you for that, thank you for your advocacy, thank you for your impact on our economy and our national security, and thank you for doing your best.

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Newport News Shipbuilding, a Division of HII  
Northrop Grumman Navigation & Maritime Systems Division

**SILVER**

Advanced Acoustic Concepts  
HDR  
Innovative Defense Technologies  
Leonardo DRS  
Penn State Applied Research Laboratories  
Progeny Systems  
Raytheon  
Ultra Electronics Ocean Systems  
Xator Corporation

**BRONZE**

AECOM  
Alion Science & Technology  
CEPEDA Associates  
In-Depth Engineering  
Oceaneering International  
Pacific Fleet Submarine Memorial Association  
Sargent Aerospace & Defense  
Sonalysts  
Systems Planning & Analysis



## Naval Submarine League Corporate Members

### Advanced Acoustic Concepts

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concepts.com

Advanced Acoustic Concepts, LLC (AAC), a Thales-DRS joint venture, provides innovative solutions for sonar detection and classification, underwater weapons, torpedo defense, advanced distributed training, portable and scalable C3 mission modules for unmanned systems and, in general, software engineering and systems integration. These products run in open architecture environment which employ mainstream readily available commercial license-free hardware and software. AAC has been selected by the U. S. Navy as a lead contractor for surface ship ASW and LCS mission modules.

### AECOM- Management Services Group

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A premier, fully integrated professional and technical services firm positioned to design, build, finance, and operate infrastructure assets around the world for public- and private-sector clients. We are a leader in all of the key markets that we serve — including transportation, facilities, environmental, energy, oil and gas, water, high-rise buildings and government — and provide a blend of global reach, local knowledge, in-

novation and technical excellence in delivering customized and creative solutions that meet the needs of our clients' projects.

### Alion Science and Technology

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Alion creates alliances between science and big government. Alion Science and Technology is an employee-owned development and research company that provides scientific, engineering, information technology research and consulting services primarily to federal agencies. More than 90% of its revenue comes from contracts with the US Department of Defense (DOD), especially the Navy. Focusing on national defense, homeland security, energy, and the environment, Alion specializes in naval architecture and marine engineering, defense operations, modeling and simulations, technology integration, and wireless communications.

### Amadis, Inc.

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AMADIS, INC is a Veteran-Owned Small Business Corporation registered in State of Delaware. Incorporated May 1991 providing Engineering and Management Services, principally for the international maritime industry and government. Amadis is a recognized leader in international maritime standardization.

### Applied Mathematics, Inc.

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Applied Mathematics, Inc., is a technical consulting firm with offices in Gales Ferry, Connecticut near the U.S. Naval Submarine Base New London. Since 1980, we have completed over 200 research and development projects for U.S. and foreign government agencies and industry. Areas of applications include submarine warfare, search and tracking, sensor data fusion, search and rescue, clinical informatics, Uncertainty Quantification, and vineyard analytics. Algorithms developed by Applied Mathematics, Inc., are in use on U.S. and UK submarines.

### American Systems

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AMERICAN SYSTEMS is an employee-owned federal government contractor supporting national priority programs through our strategic solutions in the areas of: Enterprise IT, Test & Evaluation, Acquisition & Lifecycle Support, Engineering & Analysis, and Training. AMERICAN SYSTEMS has been a proud solutions provider to the Submarine Force since our founding in 1975. We know what's at stake.

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ASSETT was founded by Key Leadership and talent from IBM's Federal Systems Division Manassas who each had more than 30 years of experience providing advanced system design and lifecycle support for Department of Defense and commercial clients with expertise spanning the spectrum from patent-level innovation development to managing large projects. ASSETT, Inc. is a versatile engineering firm that helps clients succeed with complex projects – whether for defense, business or government goals. Our executive team has directed critical programs for the Navy and commercial industry. We're known for combining leading-edge capabilities with solid principles of honesty, discipline, and long-term dependability... and we're honored to see clients return, project after project.

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BAE Systems is a global defense, aerospace and security company employing around 88,200 people worldwide. Our wide-ranging products and services cover air, land and naval forces, as well as advanced electronics, security, information technology, and support services. We serve the needs of our customers by delivering a wide range of advanced defense, aerospace and security solutions that provide a technological and performance edge. We work together with local partners to engineer, manufacture, and develop the

innovations that sustain economies, increase defense sovereignty and safeguard commercial interests.

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Every day, the people of Battelle apply science and technology to solving what matters most. At major technology centers and national laboratories around the world, Battelle conducts research and development, designs and manufactures products, and delivers critical services for government and commercial customers. Headquartered in Columbus, Ohio since its founding in 1929, Battelle serves the national security, health and life sciences, and energy and environmental industries. For more information, visit [www.battelle.org](http://www.battelle.org).

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The Boeing Company is the world's largest aerospace company and leading manufacturer of commercial jetliners, defense, space and security systems, and service provider of aftermarket support. As America's biggest manufacturing exporter, the company supports airlines and U.S. and allied government customers in more than 150 countries. Boeing products and tailored services include commercial and military aircraft, satellites, weapons, electronic and defense systems, launch systems, advanced information and communication systems, autonomous systems, and performance-based logistics and training.

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Terrorism, cyber threats, and ever-changing international dynamics make providing for our national security more complex than ever. We help our military services take on new missions, tackle acquisition and budgeting challenges, and address warfighters' needs. We also help our defense and intelligence clients modernize and adopt innovative technologies, bridging the gap they face between rising mission responsibilities and declining mission funding with our consulting and technology expertise and heritage. Our founder was a veteran. Our oldest current client—more than 75 years and counting—is the U.S. Navy. Nearly half of our leaders are veterans. And nearly one-third of our employees have a military background. We are committed to both tackling the military's toughest challenges and helping our veteran, reservist, and military spouse employees thrive. Together, we'll protect our nation and care for those who served.

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BWX Technologies, Inc. (BWXT) is a leading supplier of nuclear components and fuel to the U.S. government. BWXT provides technical, management and site services to support government in the operation of complex facilities and environmental remediation activities; and supplies precision manufactured components, services and CAN-



DU® fuel for the commercial nuclear power industry.

## CACI

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CACI provides information solutions and services in support of national security missions and government transformation for Intelligence, Defense, and Federal Civilian customers. A Fortune World's Most Admired Company, CACI is a member of the Fortune 1000 Largest Companies, the Russell 2000 Index, and the S&P SmallCap600 Index. CACI's sustained commitment to ethics and integrity defines its corporate culture and drives its success. With approximately 18,700 employees worldwide, CACI provides dynamic career opportunities for military veterans and industry professionals to support the nation's most critical missions.

## CEPEDA

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**Services:**

*Engineering and Design*

- Development
- Reverse Engineering
- Prototyping
- Product Support
- Acoustic & Operational Testing
- Product Qualification

*Navy-Approved Welding & Non-Destructive Testing*

- GTAW: Stainless steel, carbon steel, aluminum, Hastelloy, Incoloy
- GTAW: Socket welds in stainless steel down to 0.035" wall thickness
- SMAW: Stainless steel, carbon steel

bon steel

- Plasma Needle Arc: Hastelloy
- GMAW-P: Stainless steel, carbon steel

*Build-to-print*

*Large-Scale Custom Machining*

CEPEDA's product line includes: CO2 Scrubbers, CO/H2 Burners, Automatic High Pressure Dehydrators (AHPD), Missile Dehumidification and Drying Machine, CO2 Absorbent Canister Receptacles (Hoppers), Demineralizers, Hydraulic Accumulator Contents Indicators, Operating Rods, Piston Rods, Valve Components, Actuators, Candle Furnaces, Fire Extinguisher Brackets.

## Cogitic

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Cogitic is a Colorado-based engineering and manufacturing company specializing in complex geometry components and assemblies produced from difficult-to-machine materials, for critical applications. Cogitic's specialty is "medium size" components, with capability of full five-axis machining up to  $\phi 60'' \times 72''$ , horizontal turning up to  $38'' \times 176''$ . Cogitic also has a full array of in-house support processes including welding and brazing to TechPub S9074-AR-GIB-010/278, precision grinding, hydrostatic, temperature, and thermal shock testing, and ultrasonic stress relieving.

## CUNICO

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CUNICO, is the leading manufacturer of specialty fittings (nuclear/non-nuclear), piping systems and valves for the U.S. Navy. CUNICO has unique capabilities, focused on submarine and aircraft carriers. CUNICO specializes in nuclear fittings and non-nuclear fittings, mil-spec valves for the US Navy and the prime defense contractors for the Nuclear Submarines (SSNs), Nuclear Aircraft Carriers (CVNs), and U.S. Navy (USN) Surface Ships. Our products are also sold to the Navy of other countries worldwide. Products include custom fittings (all sizes, materials and pressure classes), plug valves, cartridge valves, manifolds, reducing stations, regulator valves, custom valves and assemblies are our specialty that we manufacture to specific customer specifications.

Related company, Dynamic Controls Ltd. (DCL), is the "Leader by Design" of high and low pressure cartridge valves, manifolds, reducing stations and fluid/gas systems for critical, demanding applications.

DCL has an extensive, growing installed base in excess of 60,000 cartridges (as of December 2015) on Nuclear Submarines, Diesel Electric Submarines, Aircraft Carriers, Navy Surface Ships and Gas Control systems for Rocket Launch pad(s) and LNG Gas Supply System for ME-GI Gas-Injection System manifolds for shipping vessels.

## Curtiss-Wright

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Curtiss-Wright's Defense segment provides our nation, and several international defense forces, with vital aerospace, ground and naval defense systems and support. Reflecting our strong presence on key platforms, Curtiss-Wright is well positioned even in challenging defense environments, providing a wide range of

solutions and critical technologies required for today's most demanding defense applications, from controlling the lift, flight and landing of aircraft to stabilizing the weapons systems on armored tanks.

## Cydecor

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Cydecor is a certified SDVOSB supporting maritime expeditionary programs across the US Navy and Naval Special Operations Command for more than a decade. From the earliest years of our corporate history, Cydecor has leveraged best practices and incentivized productivity, assisting highly interdependent DoD organizations in providing innovative efficiencies to maximize resources towards essential mission requirements. We employ a flat, agile operational structure—a lean corporate overhead that has allowed our company to maintain a customer-centric approach coupled with the highest quality standards.

## Deloitte Consulting LLP

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As part of the largest management consultancy in the world, our consultants offer global experience and local knowledge to help you succeed in any public or private business environment. With more insightful business perspectives, we help focus your strengths, push your capabilities, and innovate for the future. Our consulting firm is organized into three primary service areas that power the potential of your business: Human Capital leverages research,

analytics, and industry insights to help design and execute critical programs from business driven HR to innovative talent, leadership, and change programs. Strategy & Operations works with senior executives to help them solve their toughest and most complex problems by bringing an approach to executable strategy that combines deep industry knowledge, rigorous analysis, and insight to enable confident action. Technology delivers solutions that help drive transformation, improve productivity, and streamline business operations. Our practical, innovative solutions are linked to measurable goals to help our clients achieve competitive advantage.

## Delphinus

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Founded in 1994 as a small, diversified professional services company, Delphinus today employs more than 500 professional and technical personnel supporting a customer base that spans the Defense and Federal markets. A successful graduate of the Small Business Administration's 8(a) program, we have evolved into a leading provider of expert services in our core competencies of Information Technology, Marine Engineering, Marine Services, Facilities Operations & Maintenance and Business Management. Headquartered in Philadelphia, Pennsylvania, we have primary offices in Norfolk, Virginia; San Diego, California; and Bremerton, Washington, and a satellite offices in Huntsville, Alabama. Delphinus Engineering plans on expanding their operations and opening a satellite office in Honolulu, Hawaii this summer. Delphinus Marine Engineering is ISO-9001:2008 registered. Delphinus is actively engaged in expanding our support to the US Navy Submarine Force.

## Draper

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At Draper, we believe exciting things happen when new capabilities are imagined and created. Whether formulating a concept and developing each component to achieve a field-ready prototype or combining existing technologies in new ways, Draper engineers apply multidisciplinary approaches that deliver new capabilities to customers. As a not-for-profit research and development company, Draper focuses on the design, development and deployment of advanced technological solutions for the world's most challenging and important problems.

## Electromet Corporation

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Electromet Corporation (EMCorp), in operation since 1974, is a recognized leader and trusted Defense Industry partner, providing comprehensive world class solutions in the field of electronic packaging products and precision metal components for naval, fixed and mobile installations. Our advanced experience in the Defense Sector means we know what it takes to deliver the military-grade electronic enclosures and precision components that are proven rugged and survivable on today's modern defense platforms. Our full-service, in-house manufacturing capability enables us to completely control quality, delivery and cost. It also gives us the ability to quickly and easily adapt to changing requirements, modify a process to improve



value or performance, or to reduce cost and lead-time. We're committed to delivering those values that make our customers long-term partners.

### General Dynamics Applied Physical Sciences

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Applied Physical Sciences Corporation (APS) is a growing research and development company specializing in innovative technology solutions for emerging challenges in both national security and commercial markets.

The foundation of our problem solving approach is a fundamental understanding of physics and advanced mathematics. Applying sound engineering principles based on science, we tailor our technical solutions to meet our customers' most critical needs.

Our laboratories and manufacturing facilities provide the flexibility to rapidly build prototypes to address immediate needs as well as experiment with new innovations for the future. Our employees, our partners and our customers benefit from our commitment to integrity, initiative, and innovation.

As a wholly owned subsidiary of General Dynamics, we offer the agility and entrepreneurial spirit of a small company as well as access to the extensive resources of a large corporation. On a daily basis, we live our motto: "Engineering Solutions through Science."

### General Dynamics Electric Boat

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For more than a century Electric Boat has partnered with the U.S. Navy to deliver submarines with the most advanced undersea capabilities in the world. Over that time, Electric Boat has achieved a number of significant first – delivering what would be the Navy's first commissioned submarine, its first welded-hull submarine, its first nuclear submarine, and its first strategic-deterrent submarine. Today, the company is engaged in serial production of the Virginia-class submarine; design of the Columbia Class, the next-generation ballistic-missile submarine; and development of the Virginia Payload Module.

The company was established in New Jersey in 1899 to complete the world's first practical submarine, the Holland, and has maintained a presence in Southeastern Connecticut since 1911 when it established an operation in Groton to build diesel engines. Electric Boat's other primary facilities are New London, Conn., and Quonset Point, R.I.

### General Dynamics Mission Systems

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General Dynamics Mission Systems is a business unit of General Dynamics, a global aerospace and defense company. We are a leading provider of mission critical C4ISR systems across the land, sea, air, space and cyber domains. For more than 50 years we have successfully applied our systems engineering and integration expertise on every U.S.

submarine across a range of complex strategic and conventional weapons systems. Our Maritime and Strategic Systems business is a recognized industry leader in developing, manufacturing, installing and supporting high consequence undersea systems for the Department of Defense, federal agencies and commercial customers. We apply unmatched platform-centric expertise to undersea sensors, undersea infrastructure, and a family of Unmanned Undersea Vehicles (UUVs). Our Cyber and Electronic Warfare business is leading, advancing and transforming cybersecurity to ensure the safety of our nation.

### General Tool Company

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General Tool Company is an award-winning supplier of mission critical hardware and systems to the world's leading Aerospace, Defense and Commercial manufacturers. GTC's forte is meeting our clients' biggest challenges on new or long running projects. We use DFM- Design for Manufacturability-skills along with unique technologies, such as large multi-axis machine tool platforms, Friction Stir Welding, Robotic welding or Diamond tooling. The foundations for our success are our technical expertise, our commitment to the highest technology machine tools and ancillary systems, as well as our project management team that keeps customers up to date. We are located northwest of Cincinnati in the suburb of Reading where the Kramer family founded the company in 1947. We are guided by our Company Values that stress teamwork, integrity and open communication in a collaborative and learning environment.

## Georgia Technical Research Institute

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The Georgia Tech Research Institute (GTRI) is the nonprofit, applied research division of the Georgia Institute of Technology (Georgia Tech). Founded in 1934 as the Engineering Experiment Station, GTRI has grown to more than 2,000 employees supporting eight laboratories in over 20 locations around the country, and performs more than \$350 million of problem-solving research annually for government and industry. Each day, GTRI's science and engineering expertise is used to turn ideas into workable solutions for our customers. We take the best ideas, often co-developed with our Georgia Tech academic partners, and turn them into systems applications that provide a significant technological advantage over other approaches. GTRI's renowned researchers combine science, engineering, economics, policy and technical expertise to solve complex problems for the U.S. federal government, state and industry. We develop highly effective, practical solutions that we put into action. As a non-profit research institute, we are an objective partner who delivers workable solutions and manufacturable products. Our highly specialized laboratories and interdisciplinary research centers allow us to bring the right mix of talent, experience and creativity to every project.

## Globe Composite Solutions

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Globe Composite Solutions is a full-service design-to-manufacturing company which provides innovative and cost-effective composite-based applications for the Defense industry. We specialize in material development, part design, prototyping and complex manufacturing of metallic and non-metallic components. Originally founded in 1890, Globe is unique among non-metallic specialists because we have rapid prototyping, machining and fabrication capabilities as well as extensive mechanical and material testing services. We are ISO 9001:2015 certified, have DoD Security Clearance, as well as expertise in: acoustics, corrosion resistance, hydrolytic stability, structural integrity at extreme depths, high-performance gaskets and seals as well as impact & shock resistant parts. Globe can also assist research labs in a wide variety of new technology development and component possibilities. Our engineers and material developers have deep experience in researching and finding creative solutions that enable our customers to more effectively accomplish their mission.

## Gryphon Technologies

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Gryphon Technologies LC, headquartered in Washington, DC, is a premier professional and engineering services provider specializing in warfare systems and integration, naval architecture and marine engineering, program management, test and evaluation, and logistics. Gryphon provides the skills necessary to manage the development and operations of these mission critical systems. For almost 20 years, the Company has designed, integrated, maintained, and upgraded state-of-the-art systems for the Department of Defense. Gryphon Technologies is the

federal government's partner working in support of mission critical systems. We are proud of our ability to help shape tomorrow, while ensuring today's U.S. and coalition forces can carry out their critical missions and tasks.

## Harris

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From ocean to orbit and everywhere in between, Harris provides mission-critical solutions to connect, inform and protect the world. Harris is a proven leader in tactical communications, electronic warfare, avionics, air traffic management, space and intelligence, and weather solutions. Harris delivers its innovative solutions through its three business segments: Communication Systems, Electronic Systems and Space and Intelligence Systems.

## HDR, Inc.

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HDR is more than just traditional architecture, engineering, and environmental services. We understand the complex nature of planning and design required for large facilities for defense clients. We have the experience required to work with numerous agencies, administrations, and users to balance diverging interests and build consensus. Our projects range from minor renovations to multi-million dollar, new construction of our nation's most mission-critical assets, including laboratories, SCIFs, cybersecurity, hangars and maintenance facilities,



EMP resistant facilities, and cybersecurity of control systems. Our teams work together to deliver technically sophisticated, unique, facility designs in secure environments for our defense clients around the world.

### Hilarides Partners, LLC

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Located in the Washington, DC area, Hilarides Partners delivers engineering, technical and consulting services critical to the US Department of Defense. With over 35 years of proven leadership in energy, intelligence, defense and shipbuilding we strive to provide business solutions that support the nation's most critical missions.

### Hunt Valve Company

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Hunt Valve Company was founded 1919 to manufacture severe service valves for the U.S. steel industry. Hunt Valve's affiliation with the U.S. Navy dates back to the early days of submarine development with the supply of pneumatic valves that were used to control the periscope's up/down function. This valve was later used in similar submarine applications such as for the snorkel's up/down function. Hunt Valve also supplied valves for the first nuclear-powered submarine, the USS Nautilus in the early 1950's. Today's Hunt Valve produces innovative engineering solutions that can be found in applications on all six industrialized continents. The company specializes in severe-duty

valves, electromechanical actuators, and system solutions for applications that include primary metals, energy, process and U.S. Navy nuclear-powered vessels, including all submarines and carriers in operation as well as the Virginia Class, Ford Class and soon-to-be-in-production Columbia Class.

### Hydro Group Systems Inc.

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Hydro Group Systems Inc. specializes in the design and manufacture of subsea and harsh environment electrical and optical connectors, penetrators, cable assemblies and terminations for the oil & gas, renewable energy and defense industry. Building on three decades of proven capability and industry experience, Hydro Group has become the market leader in providing bespoke engineered cable/connector assembly solutions for subsea applications in both domestic and international markets. Hydro Group are at the forefront in the development and innovation of subsea product technologies, with involvement from prototype concept through to design, manufacture and project management. Hydro Group manufacture the complete package including FAT at its state-of-the-art facilities in Aberdeen, Scotland; umbilical cables, electrical and optical connection systems / assemblies for data, power and signal transmission. Our focus is primarily in subsea cable/connector assembly innovation. Our day to day business concentrates on product design, engineering and manufacturing of harsh environment composite cables, underwater connectors, topside connectors and penetrators for subsea, underwater, topside and onshore applications.

### Hydroid, Inc.

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Hydroid is a field-proven technology leader in advanced marine robotics, specifically autonomous underwater vehicles (AUVs). The company designs and manufactures state-of-the-art solutions for use in a number of applications including marine research, commercial and defense. Located in the U.S., Hydroid is a subsidiary of Kongsberg Maritime, the world's most trusted manufacturer of AUVs. REMUS vehicles provide innovative and reliable full-picture solutions. Together, they represent the most advanced, diversified and field-proven family of AUVs and vehicle support systems in the world.

### IMES

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Assessing Risk, Delivering Integrity™ Imes is an international engineering services company that provides lifting inspection and specialist engineering services. We exist to ensure our clients maintain the capability and availability of mission critical assets, such as cranes, fixed and loose lifting equipment and specialized structures. Imes is experienced in managing complex schedules of inspection work in challenging environments – where critical infrastructure maintenance and integrity assurance is vital. Major players across key sectors trust us with managing asset integrity across their complex lifting fleets. We work with the cream of the offshore oil and gas



sector operators, US and UK Navies, and major European refineries. They trust limes to be a key component in their supply chain.

### In-Depth Engineering Corporation

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In-Depth Engineering is a leading small business provider of combat systems solutions; development, integration and test services, and waterfront support to the United States Navy. Our programs and efforts span the development and deployment lifecycle; from applied research (SBIR programs), to 6.3 advanced development programs (APB, ACB and ASB), to engineering development programs (e.g. AN/SQQ-89, AN/BQQ-10, AEGIS ACB-20, IUSS, AN/BVY-1, SSTD, AEGIS, CSEA), system integration and test (e.g. In-Depth is the LCS signal processing subsystem integrator), hardware design and integration (e.g. IUSS ship electronics design, assembly, installation and test), ship integration and waterfront installation and test support (AEGIS Ship Integration and Test), and logistics and training systems (e.g. Adaptive Sonar, Combat and EW Training Systems).

### Innovative Defense Technologies

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Innovative Defense Technologies (IDT) is an information technology business headquartered in Arlington,

VA. Founded in 2006, IDT designs and develops best-in-class solutions that enable the rapid delivery of software-based capabilities for the Department of Defense (DOD). IDT's objective is to enable higher quality software to be deployed faster and more affordably through automation. Our technology and expertise facilitate the efficient integration, testing, analysis, and certification of complex, mission-critical systems—accelerating the delivery of capabilities to the warfighter. The company has additional offices in Fall River, MA; Mt. Laurel, NJ; and San Diego, CA.

### iXblue Defense Systems, Inc.

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iXBlue is a leading global provider of innovative solutions and services for navigation, positioning, and imaging. Civil and defense customers rely on our systems, operations, and services for the challenges they face at sea, on land, in the air or in space. We are recognized throughout the industry for our pioneering work on the development of ultimate performance fiber-optic gyroscopes (FOG), acoustic and sonar signal processing, and inertial-acoustic sensor data fusion. In all of these areas, we work to ensure that our products provide high accuracy, unrivalled performance and unsurpassed reliability. iXBlue's offerings encompass inertial navigation systems, photonic components and modules, acoustic positioning and sonar solutions, imaging systems, motion simulators, and stabilized platforms. Our solutions are used in challenging applications, including offshore construction and dredging, geophysics and hydrography, ocean science, maritime vessels and yacht-

ing, fishing, naval and land defense, land and air survey, optical communications and instrumentation, as well as aerospace.

### JRC Integrated Systems, Inc.

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JRC INTEGRATED SYSTEMS, INC. is a Service-Disabled, Veteran-Owned Small Business (SD-VOSB) that provides advanced professional services to solve complex problems for the Department of Defense (DoD) and other government agencies. JRC has the experience and knowledge to help solve your most challenging problems. With employees with decades of operational experience and highly skilled engineers developing innovative solutions, we are able to provide the right people for the right challenge. Our expertise develops smart solutions. JRC provides an independent source of expertise that is free of organizational conflict of interests (OCI). Our employees will provide you an unbiased analysis that you can trust. We can help guide competing interests to provide the right solution. Independence produces trustworthy results. At JRC, we are motivated to build, create, and contribute. We are driven by the mission to help keep America and her allies safe. The success of our customers demonstrates the results of our work. Mission-driven results ensure the outcomes that you need.

### Joe Buff Inc.

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Joe Buff Inc., “An Independent Think Tank of One,” specializes in writing and speaking about rigorous intellectual capital for nuclear submarine advocacy; Joe takes a historicist-futurist perspective on undersea warfare policy and strategy. He has a number of articles in THE SUBMARINE REVIEW since 1998, including two first-prize NSL literary award winners, about China (2006) and Russia (2016). Experienced in pure math (algebraic topology) and applied math (actuarial science), he is currently engaged in a multi-year study of 21st century nuclear deterrence conundrums and open questions, developing some best practice suggestions for America’s (and other countries’) “nuclear posture after next.” Joe has also published six Captain Jeffrey Fuller/USS CHALLENGER submarine technothriller novels; the latest of these won the 2006 Admiral Nimitz Award for Outstanding Naval Fiction from the Military Writers Society of America. The series is a cautionary saga of near-future tactical nuclear war at sea.

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For more than 75 years, The Johns Hopkins University Applied Physics Laboratory (JHU/APL) has provided critical contributions to critical challenges through systems engineering and integration, technology research and development, and analysis. Our scientists, engineers, and analysts serve as trusted advisors and technical experts to the government, ensuring the reliability of complex technologies that safeguard our nation’s

security and advance the frontiers of space. We also maintain independent research and development programs that pioneer and explore emerging technologies and concepts to address future national priorities.

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L3 Technologies is a leading provider of a broad range of communication, electronic and sensor systems used on military, homeland security and commercial platforms. L3 is also a prime contractor in aerospace systems, security and detection systems, and pilot training. For more than a decade, L3 has delivered superior performance to the U.S. government, our allies and leading corporations throughout the world. As a top ten defense contractor in the world, we know the critical role our products and services play in the protection and defense of freedoms worldwide. We take our responsibility very seriously, and we are privileged to support our customers and the men and women who get the job done.

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For more than 40 years we have been tackling some of the biggest problems that face our nation and our world. We bring a mix of innovative technology and sector expertise to customers in defense, intelligence, civil, and health markets. Our approach is holistic, looking at all the interconnected complexities of a

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Leonardo DRS, based in the United States, is a leading supplier of integrated products, services and support to military forces, intelligence agencies and prime defense contractors worldwide. Through the acquisition of DRS Technologies in 2008, Leonardo is one of the most qualified and internationalized global players in defense electronics, with a strong presence in the U.S. market. With nearly 5,500 employees in 65 facilities in the United States, Canada and locations around the world, Leonardo DRS is a world leader across a range of state-of-the-art technology for military and civilian government customers primarily in the U.S., Canada, Australia, the Middle East and Asia. The Leonardo DRS’ product range is also available in the UK customers through the country’s Tactical Systems team. Leonardo DRS satisfies customers’ needs in the aeronautical, land and naval sectors through five core areas of capability and hundreds of individual programs. These core capability areas include: naval power and electronics, network and computing, electro-optic and infrared systems, combat support systems, and global communications.

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Liquid Robotics designs and manufactures Wave Gliders, the first wave and solar powered unmanned ocean robots. With our partners, we address many of the planet's greatest challenges, by transforming how to assess, monitor, and protect the ocean. We solve critical problems for defense, commercial, and science customers. Visit [www.liquid-robotics.com](http://www.liquid-robotics.com) to learn more. Liquid Robotics and Wave Glider are registered trademarks of Liquid Robotics, Inc. a wholly-owned subsidiary of Boeing.

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Headquartered in Bethesda, Maryland, Lockheed Martin is a global security and aerospace company that employs approximately 100,000 people worldwide and is principally engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems, products and services. Lockheed Martin delivers systems, sensors and payloads that help the Navy achieve acoustic superiority and mission success in the undersea domain.

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Major Tool & Machine Inc. (MTM) has a 72 year history providing contract manufacturing services in support of Tier I and government-direct customers. Our commitment to the Navy, through the manufacture of component parts and assemblies that require welding, machining, and manufacturing engineering services, is unyielding. Our specialty is the manufacture of medium-to-large, complex components and assemblies to close tolerances from all varieties of special alloys. We serve our customers worldwide by offering turnkey services with a defense in depth approach to manufacturing. Major Tool & Machine continues to evolve with the needs of our Naval customers. As an SBA registered small business, employing 400 skilled personnel operating out of our 600,000 sq. ft. world-class campus in Indianapolis, IN, Major Tool & Machine is driven to provide mission assurance through our unwavering dedication to quality, service, our people, and technology.

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With over 200 patents and 75 years of experience, Marotta Controls has become a leading control solutions provider for complex technical challenges. System designers turn to Marotta for solutions they need for controlling pressure, motion, fluid, electronics and power. Advanced technologies include precision valves, manifolds, power conversion, motor controls and control actuation systems that are easily integrated into shipboard and sub-sea applications, weapons systems, military aircraft, and government and commercial spacecraft. Discover how Marotta's evolved control system technologies provide a strategic advantage with optimized design,

reduced risk and increased reliability. Visit [www.marotta.com](http://www.marotta.com) to learn more.

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Metron is a scientific consulting company dedicated to solving challenging problems in national defense through the development and application of advanced mathematical methods. Problem solutions are realized in computer software with graphical interfaces that allow a user to understand and act on the results without having to comprehend the intricacies of the models themselves. Metron's employees are leaders in their technical fields who have made the commitment to solve real-world problems. They excel in statistical inference, operations research, physical modeling, and software development. Our success depends upon recruiting and retaining the best talent available in the fields of applied mathematics, physics, and computer science. At Metron, we believe that employees should combine their innate talent with a willingness to work on challenging problems and to extend their knowledge to other disciplines. This philosophy allows us to create a team-based approach to problem solving and product development that has been highly successful.

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The MITRE Corporation's mission-driven team is dedicated to solving problems for a safer world.



We are a not-for-profit company that operates multiple federally funded research and development centers (FFRDCs). We work across the whole of government, through our FFRDCs and public-private partnerships, to tackle problems that challenge our nation's safety, stability and well-being. Our unique vantage point allows us to provide innovative, practical solutions in the defense and intelligence, aviation, civil systems, homeland security, judiciary, healthcare, and cybersecurity spheres.

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Over fifty years ago, Moog, Inc. started as designer and supplier of aircraft and missile components. Today, our motion control technology enhances performance in a variety of markets and applications, from commercial aircraft cockpits, to power-generation turbines, to Formula One racing, to medical infusion systems. In space and defense, Moog is the premier motion and flow control solutions provider for the following markets: satellites, human-rated space vehicles, launch vehicles, missiles, military ground vehicles, naval vessels, and security and surveillance.

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Murray Guard, Inc. is a privately held, US-based security contractor

with a strong focus on people, performance and accountability — and a strong commitment to building long-term relationships with our customers. We were founded in 1967 by Tennessee state representative Roger Murray, Jr. with a progressive mission: to raise the bar in the security industry by providing officers with the professional development and management support they need to deliver the highest possible performance and integrity on the job. Headquartered in Jackson, Tennessee, we primarily serve clients in regulated and compliance-driven industry, government and other sectors in 13 southeastern states and Puerto Rico.

### Newport News Shipbuilding, a Division of Huntington Ingalls Industries

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Newport News Shipbuilding is the sole designer, builder and refueler of U.S. Navy aircraft carriers and one of two providers of U.S. Navy submarines. With approximately \$4 billion in revenues and more than 20,000 employees, we are the largest industrial employer in Virginia and the largest shipbuilding company in the United States. We build the most advanced ships in the world using our expertise in nuclear propulsion, naval design and manufacturing. We are currently building the new Gerald R. Ford-class aircraft carriers and Virginia-class fast-attack submarines, and performing Refueling and Complex Overhaul (RCOH) on Nimitz-class aircraft carriers.

### Nord-Lock Group

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As a global leader in bolting solutions, Nord-Lock Group strengthens the public and industrial infrastructures that shape modern living in decades to come. You can rely on our unique combination of secure bolting solutions and industry expertise to solve your toughest bolting challenges. Our solutions include Nord-Lock wedge-locking washers that keep bolted joints secure under any level of vibration, Superbolt multi-jackbolt tensioners that require only hand tools to install, Boltight state-of-the-art hydraulic tensioning system, and Expander system, a permanent solution for lug wear on equipment. Our high-quality products are manufactured at state-of-the-art production facilities in North America, Sweden, United Kingdom, Switzerland. Our production focuses on conducting multiple quality controls and producing genuine products that are assigned with unique control numbers to ensure full traceability. The extensive certifications we have been awarded from independent testing facilities confirms our market position and commitment to quality. The Nord-Lock Group is now the first bolt-securing partner to offer a full life-cycle warranty across all of its technologies.

### Northrop Grumman Navigation & Maritime Systems

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Northrop Grumman is a leading global security company offering a broad portfolio of capabilities and technologies that enable us to deliver innovative products, systems and solutions for applications that range from undersea to outer space and into cyberspace. We provide products, systems and solutions in autonomous systems; cyber; command, control, communications and computers, intelligence, surveillance, and reconnaissance (C4ISR); strike; and logistics and modernization in support of customers worldwide. With more than 60,000 employees in all 50 states and in more than 25 countries, we strive to attract and retain the best employees by providing an inclusive work environment wherein employees are receptive to diverse ideas, perspectives and talents to help solve our toughest customer challenges: to develop and maintain some of the most technically sophisticated products, programs and services in the world.

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NDFG partners with clients to navigate and simplify the modern complexities of business and technology, delivering the insights, solutions and outcomes that matter most. As a division of NTT DATA Corporation, a top 10 global IT services and consulting provider, we wrap deep industry expertise around a comprehensive portfolio of infrastructure, applications and business process services.

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Oceaneering Advanced Technologies (ADTECH) partners with our customers to deliver solutions that enable humans to work safely and effectively in harsh environments -ranging from the depths of the sea to the outer reaches of space. Our innovative solutions support the development and application of practical cost-effective systems that meet challenges – from the routine to the extreme. Our experience and expertise across multiple industries uniquely positions us as a leader in the government, entertainment, logistics, space, and marine service markets. Our products and services meet the rigorous demands of the complex environments in which they operate delivering results with uncompromised safety and reliability.

**ORBIS**

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ORBIS is a Veteran Owned Small Business (VOSB) with over 17 years of major Navy Program experience providing Engineering, Technical, and Consulting Services to DoD and Commercial Customers. ORBIS is an ISO 9001:2015 certified, customer-focused company with a proud record of providing exceptional service and technical support to DoD/DON clients and our commercial clients. Our corporate headquarters are in Charleston, SC and regional business units located at the Washington Navy Yard, DC; Portsmouth, NH; Picatinny Arsenal, NJ; PA; Phil-

adelphia, PA; and Norfolk, VA along with satellite offices in Huntsville, AL; Newport, RI; San Diego, CA and Aberdeen, MD.

**Orbital ATK**

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As a global leader in aerospace and defense technologies, Orbital ATK designs, builds and delivers space, defense and aviation-related systems to customers around the world both as a prime contractor and as a merchant supplier. Our main products include launch vehicles and related propulsion systems; satellites and associated components and services; composite aerospace structures; tactical missiles, subsystems and defense electronics; and precision weapons, armament systems and ammunition. Headquartered in Dulles, Virginia, Orbital ATK employs approximately 14,000 people across the U.S. and several international locations. Orbital ATK is composed of three operating groups: flight systems, defense systems, and space systems. The defense group is an industry leader in propulsion and controls for air-, sea- and land-based tactical missiles and missile defense interceptors, fusing and warheads for tactical missiles and munitions and is a supplier of advanced defense electronics for next-generation strike weapon systems, missile-warning and aircraft survivability, and special-mission aircraft.

**Pacific Fleet Submarine  
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The Pacific Fleet Submarine Memorial Association was established in 1978, to operate and maintain the Pacific Fleet Submarine Museum as a memorial to those gallant Sailors who manned the Submarine Force in WWII, during the Cold War, today and into the future; to maintain the Fleet Submarine USS BOWFIN (SS 287), for permanent display in Hawaii, as an educational tool and as an inspiration to present and future generations; to create an Educational Outreach Program including an endowed Bowfin Scholarship Program; and be a centerpiece for public awareness and understanding of the Submarine Force including its evolution, history and future.

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Padgett Ventures LLC, based out of Connecticut, is a defense consulting firm with proven leadership and experience. We concentrate on technology development and insertion in support of submarine platforms and payloads. We also provide business development and strategic planning support focusing on ship/submarine maintenance, modernization, and logistic support.

**Penn State Applied Research Laboratory**

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The Applied Research Laboratory (ARL) at Penn State is an integral part of the University and was established in 1945 at the request of the U.S. Navy. Originally focused on undersea weapons technology development, ARL now includes a broad research portfolio addressing the needs of various sponsors. ARL supports national security, economic competitiveness, and quality of life through education, scientific discovery, technological demonstration, and successful transition to application. As a Department of Defense (DoD) designated University Affiliated Research Center (UARC), ARL conducts essential research, development, and systems engineering in support of our nation's priorities free from conflict of interest or competition with industry. ARL is wholly reliant on sponsored research programs for operation of the Laboratory and therefore must maintain relevance to our sponsor base, as well as an operational agility to meet ever-changing requirements.

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The Potomac Advocates is a leading Washington-based consulting and governmental relations firm. We provide comprehensive, and cost-effective services to some of the world's largest corporations, small and medium sized businesses, and individuals. Our principals have served in DoD and on Congressional staffs. Our Affiliates have served in federal agencies, state and local governments, and political campaigns. Our advocacy builds a bridge of understanding to facilitate your success working with the federal government and other companies. We identify opportunities and help you win business. We have the skill, education, integrity, and determination to devise the best strategies for

Capitol Hill and federal government business initiatives. Personal relationships are critical to success--we reach beyond our role as service providers to become members of your team that are known and trusted by your federal customer.

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Founded in 1991, Preferred Systems Solutions (PSS) was originally focused on providing IT and engineering services to the commercial market. After building a successful commercial staffing practice, in 1998 PSS sold its commercial business to a publicly-owned company. PSS then shifted its mission to providing IT, engineering, and program management services to Government agencies. In September 2007, PSS was recapitalized by CM Equity Partners and its affiliates (CM EP). Since then, PSS has provided reliable, cost-effective solutions to meet our clients' goals and objectives in the core areas of: Systems & Software Engineering, Data Analytics & High Performance Computing, Cyber Security & Cloud Mission Support, Acquisition, Financial Management, and Program Management Support. PSS has a strong and diverse Government and commercial client base with key customer relationships in the Department of Defense (DoD), Intelligence Community (IC), and Civilian agencies. Our customers include the U.S. Army, U.S. Navy, Federal Bureau of Investigation (FBI), Department of Homeland Security (DHS), Defense Logistics Agency (DLA), Defense Intelligence Agency (DIA), Department of Transportation (DOT), and various Intelligence agencies. Today, PSS enjoys continued success in the

expansion of our client base through our dedication to our customers' mission success.

**PRL Industries, Inc.**

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PRL's mission is to provide exceptional quality components allowing peace of mind for our nation's military, nuclear, and industrial applications. PRL Industries, Inc., founded in 1969, provides customers with complete in-house Non-Destructive Examination and upgrading services on ferrous and nonferrous castings.

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Since 1995, Progeny Systems' mission is to be a trusted provider of innovative, cost-effective technical solutions and quality products while maintaining positive relationships with our customers, vendors, and employees. Progeny Systems is a privately-held, high-tech small business focusing on software and hardware system integration, computer-vision solutions, cutting-edge research and development, and manufacturing. We provide premium systems, services, and products for the Department of Defense, government agencies and commercial clients. As a small business, Progeny Systems is a participant in the Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) programs.

These programs complement Progeny's ability to leverage flexibility, rapid turnaround, customer responsiveness, and encourage an environment for experimental research. Progeny maintains more than 14 offices nationwide that are strategically located to better serve our customers.

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For over 50 years, QinetiQ North America (QNA) has been providing world-class technology development, engineering research and development and revolutionary products to the defense, security, commercial and consumer markets. Our product offerings include vehicle and soldier protection, unmanned systems (robots) in various sizes, maritime systems and power sensors and control systems. Customers rely on QNA to increase readiness, improve processes, streamline operations, increase situational awareness, reduce costs and enhance security. Our technology solutions and products improve manufacturing processes, reduce costs, save lives and make it easier to monitor, manage and protect complex systems and critical assets. QNA is headquartered in Waltham, MA with offices in Franklin, MA, Pittsburgh, PA and Ashburn, VA. QinetiQ North America is a wholly owned, independently operated subsidiary of QinetiQ Group PLC, one of the world's leading defense and security technology companies.

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Raytheon Company is a technology and innovation leader specializing in defense, civil government and cybersecurity solutions. In a world of emerging challenges and evolving threats, US and allied forces need to maintain the advantage over our adversaries. Raytheon leverages our legacy of performance and innovation to develop solutions to make the world a safer place. For our global navy customers, Raytheon provides technologies and solutions that span the naval domains – above, on and below the water. From radars and sonars, networks, navigation and combat management, fire control and weapons, we are uniquely capable to provide integrated, end-to-end solutions – to enable warships to detect, control and engage any threat, whether from the air, surface or undersea.

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Rite-Solutions is an award-winning software development, systems engineering, information technology and learning development firm based in Middletown, RI with satellite offices in Pawcatuck, CT, Virginia Beach, VA and Washington, DC. We are a Service Disabled Veteran Owned Small Business (SDVOSB) with over 200 employees – consisting of scientists, engineers, information technology (IT) specialists, cyber-security specialists, instructional designers and consulting professionals. The nature of the work we do is as dynamic and diverse as the makeup of our workforce. From helping the Navy maintain dominance in undersea warfare to

assisting healthcare and financial institutions improve workplace performance, Rite-Solutions helps our customers optimize their people and processes, execute their mission, and achieve organizational success. We strike a desirable and distinctive balance between being agile and, as a CMMI Level 3-appraised company, disciplined – the best of both worlds. Through this approach we are able to deliver exceptional quality and reliability with the speed and affordability that only a small business like Rite-Solutions can achieve. This isn't just a competitive advantage for us, but also a means by which we are able to maintain a talent pool of the best and brightest who we embrace as the F.E.W. or Friends Enjoying Work.

### RIX Industries

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RIX Industries manufactures a wide range of pneumatic energy storage and transfer system solutions, including reciprocating piston compressors and gas generators and liquefiers on the USS Ford-class aircraft carriers, industrial gasses and breathing air. RIX specializes in applying oil-free technology to high-pressure applications on USS Seawolf and Virginia-class submarines and other highly demanding environments. RIX has been in business since 1878 and has been proudly serving our US Armed Forces for over 120 years. With a solid industry reputation that is second to none, RIX is the established leader in American-made compressor engineering and manufacturing. A company built on trust, experience, and a solid client base of over 80% repeat customers, RIX is dedicated to making clients for life, both domestically and globally. RIX Industries' compressors and generators are used by an extensive list of customers

including industrial gas companies, refineries and chemical plants, offshore oil platforms, commercial diving, OEM's, SCUBA tank filling, and Government Agencies, all of which increases RIX's global role in strategic deterrence, homeland defense, and industrial innovation.

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SAIC is a premier technology integrator providing full life cycle services and solutions in the technical, engineering, intelligence, and enterprise information technology markets. SAIC is Redefining Ingenuity through its deep customer and domain knowledge to enable the delivery of systems engineering and integration offerings for large, complex projects. SAIC's more than 15,000 employees are driven by integrity and mission focus to serve customers in the U.S. federal government. Headquartered in Reston, Virginia, SAIC has annual revenues of approximately \$4.5 billion. For more information, visit [www.saic.com](http://www.saic.com).

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Founded in 1920, Sargent Aerospace & Defense is a premier global supplier of precision-engineered customized components as well as flight-critical aftermarket aviation services. Leveraging more than 95

years of expertise, Sargent directly contributes to the safe operation of countless commercial and military aircraft and rotorcraft, submarines and land-based vehicles. Sargent's continuing investment in people, assets, technology and process quality ensures excellence and is integral to the company's commitment to customers and their end-users. Today, Sargent performs critical functions on a variety of commercial and military aircraft, submarines and land-based vehicles in operation worldwide, and our customer base includes some of the best-known names in aerospace and defense for both the OEM and MRO marketplaces. Sargent Aerospace and Defense is fully owned by RBC Bearings, Inc.

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Design and Manufacturing Power Supplies Company, Schaefer, Inc. was founded in 1969 and has grown from a small family enterprise to a dedicated workforce of approximately 200 people in Germany, Ireland, and the USA. Schaefer, Inc. possesses a comprehensive worldwide sales network, and the company is continuously on steady growth path. Thanks to decades of experience in design and manufacturing of power supplies, Schaefer offers a large variety of products, options and enhancement features. In the field of high power requirements, Schaefer has achieved, and continues to command a leading position. Schaefer power supplies are often used for applications which demand a high level of reliability under severe environmental conditions, e.g. Railroad industry, Automotive industry, Telecommunication, Power generation plants, Chemical plants and oil refinery, Factory automation and Military industry.



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Securitas Critical Infrastructure Services (SCIS) provides specialized security and fire services to the highly regulated Aerospace, Defense, Nuclear, Government, and Aviation industries. To meet the unique needs of each industry, expert management teams guide and support operations for each business sector. SCIS has been approved by the Defense Security Service (DSS), Department of Energy (DOE), and all other government agencies to retain security clearances and operate contracts requiring security clearances. SCIS delivers the most effective security solutions by offering customized solutions to meet the requirements of any organization. The parent company of SCIS is Securitas AB, a global knowledge leader in security.

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Seemann Composites, Inc. (SCI), was founded in 1987 to develop the technology of vacuum infusion, specifically SCRIMP (Seemann Composites Resin Infusion Molding Process). Its founder, Bill Seemann, had worked for decades building fiberglass boats and distributing composite materials throughout the Gulf-South. SCI was founded on its research and development innovation with composite fabrication processes and is a recognized leader in large-scale resin infusion technology. SCRIMP enjoys world-

wide usage today and has been attributed to starting an industry-wide revolution in vacuum assisted resin transfer molding of composites. Today, Seemann Composites is primarily focused on manufacturing production components for DOD and commercial platforms, but also maintains a significant research and development capability to stay on the forefront of composites processing technology. SCI has fabricated and delivered thousands of advanced composite structures and products (of all sizes and levels of complexity) to all branches of the U.S. military, many major defense and commercial customers.

## Siemens Government Technologies

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Siemens Government Technologies, Inc. (SGT) provides solutions for our nation's greatest challenges in the federal market. SGT delivers Siemens' globally trusted and recognized offerings (products and services), in all 50 U.S. states and territories, and in many countries at U.S. government locations. With exceptional resources, proven technologies and customer focus, we help advance mission-critical programs for the federal government to manage operational demands with greater efficiency than ever before. We offer the Sea Services a variety of capabilities, including product life-cycle management, integrated power and energy systems at sea, and infrastructure solutions ashore. Whether the challenge includes upgrading and modernizing infrastructure, managing and monitoring automation technologies, improving energy efficiency, security and resiliency or shifting to renewable energy, we are helping our federal customers per-

form their missions better than ever before.

## Sonalysts, Inc.

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Sonalysts, Inc. is an employee-owned services business founded in 1973. With more than 300 degreed engineers, computer scientists, psychologists, and other professionals, we offer extensive experience and strong qualifications in a wide variety of technical disciplines including submarine operations analysis, combat system software development, human systems integration, broadcast quality media, interactive multimedia instruction, computer game and micro-simulation, adaptive distance learning, intelligent tutoring, and other related technologies.

## SSS Clutch

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SSS is the world's leading supplier of automatic overrunning clutches for low to high power applications, and for low to high speed in power generation, marine main propulsion, mid-stream and down-stream oil & gas industry applications. Of nearly 37,000 SSS Clutches which are installed worldwide, SSS Clutches are used by over fifty navies in gas turbine and combined main propulsion systems of surface ships including COGAG, COGOG, CODOG, CODAG, CODELOG, etc. arrangements. For thirty years SSS Clutches have been supplied for steam turbine



and EPM drives for submarines. EPM drive SSS Clutches are used in US Navy 6881, SSN-21, and Virginia Class submarines. SSS thanks our many customers worldwide, and in particular the US Navy, for their continued confidence in SSS Clutches for critical main propulsion applications.

**Subsystem Technologies, Inc.**

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Subsystem Technologies, Inc. (SUBSYSTEMS) is a leading provider of Engineering and Technical Services, including Manufacturing and Manufacturing Technology Support, Logistics and Field Support, Software Solutions, and Management and Mission Support services nationwide. We are a diverse company, including professionals with expertise in Science, Research, Engineering, Information Technology, and Data Sciences. Our strength is in collectively providing integrated services. We are dedicated to moving our Nation's agenda forward. It's the key ingredient that makes us who we are - like our passion for excellence, our innovation throughout our organization and our long standing customer relationships. You will see this simple philosophy at work in everything we do. It defines who we are, challenges us, forces our minds to be open, and to be a world-class company.

**Systems Planning & Analysis**

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For over 45 years, SPA has provided timely and objective analysis and integrated technical, operational, programmatic, policy, and business solutions in support of important national security objectives. Using state of the art analytic methods, modeling and simulation, and systems engineering, SPA helps decision makers forecast problems, assess risks, optimize resources, develop strategies, and test and refine new approaches. SPA's diverse team includes significant operational, technical and analytic experience across all national security domains and it is heavily involved in assisting the undersea warfare community tackle tough challenges and capitalize on new opportunities. Supporting OPNAV, OSD, the Fleet, NAVSEA, PEO Submarines, SSP, ONR/DARPA, and the Warfare Centers and Labs on matters affecting undersea warfare and systems, SPA is a recognized professional services industry leader with a proven record of accomplishment. Areas of support encompass threat and vulnerability assessments, war gaming, concepts and requirements development, capability investment tradeoffs, force operations, program management, technology transition, and physical security for national strategic assets.

**TE Connectivity**

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TE Connectivity (TE) offers harsh environment connectivity with military-grade custom interconnects and sensor products including underwater electrical and fiber optic connector technology to support your defense-related harsh environment applications. We have a long history of designing and building military connectors and system solutions. Our products are designed to

perform in both littoral, as well as very deep water applications, across a range of government platforms including submarines, surface ships, helicopters, ground vehicles, AUVs, ROVs, and UUVs. TE has the critical experience to meet MIL-SPEC system requirements that deliver reliable, high performance solutions enabling defense platforms to perform at their absolute best. Combined with the advanced technologies of TE's Rochester & Raychem engineered cables and SEACON & DEUTSCH connectors along with our full family of products, we offer a complete range of products and solutions for harsh connectivity environments.

**Teledyne Brown Engineering**

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Teledyne Brown Engineering, Inc. is an industry leader in engineered systems and advanced manufacturing. The Company provides full-spectrum systems engineering, integration, manufacturing, and lifecycle sustainment solutions to the marine, aviation, aerospace, defense, energy and environment markets. Teledyne Brown has expertise in systems integration, technology development, hardware design, prototype development, system test and evaluation, advanced manufacturing, performance-based logistics solutions, and operations and maintenance.

**ThayerMahan**

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With over 70 years of experience in maritime security issues, the



WASHINGTON (SSN 787)

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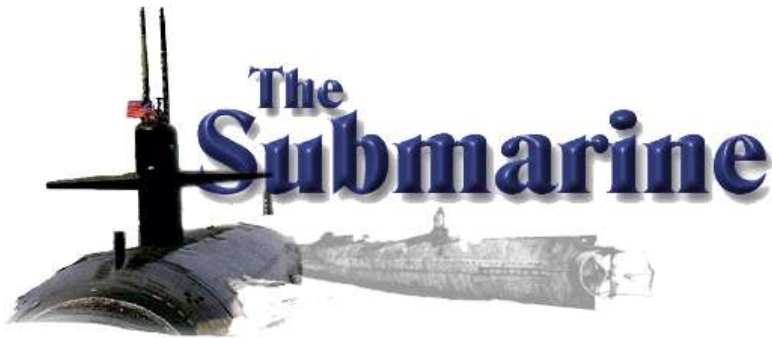
Huntington Ingalls Industries has delivered 73 submarines to the U.S. Navy over four decades. We are one of only two shipyards capable of designing and building nuclear-powered submarines and have an unrivaled record of providing fleet maintenance support around the globe.

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### Treadwell Corporation

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While designing and building oxygen generation equipment for the military is a lot of what we do, it's certainly not all that we do. Treadwell applies the same innovative thinking, visionary design capabilities and highest quality manufacturing to custom designed and manufactured electro-chemical systems, including hydrogen and oxygen generators. We also offer precision oxygen cleaning services for your military or aerospace applications.

### Ultra Electronics Ocean Systems

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Ultra Electronics Ocean Systems is a recognized technical leader in the design, development, manufacture

and support of undersea defense electronics equipment and systems. We have been a major DoD supplier for over 50 years and take pride in having successful partnerships with small business and research laboratories. Our long history with submarine communications, acoustic countermeasures, torpedo defense, Anti Submarine Warfare (ASW), transducers, and special purpose arrays are highlighted by the significant number of industry achievements that we continue to demonstrate within the defense community.

### University of Texas at Austin, Applied Research Laboratories

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Applied Research Laboratories, the University of Texas at Austin (ARL:UT), is a Department of Defense University-Affiliated Research Center (UARC). Since 1945, ARL:UT has been engaged in sponsored research dedicated to improving national security through applications of acoustics, electromagnetics, and information sciences. ARL:UT has provided both tactical and security support to the Submarine Force for many years. These efforts include delivery of capability for high frequency sonar array, active signal processing, and operator interface design and implementation; mid frequency active and passive sonar signal processing design; towed and hull array adaptive low frequency algorithm design and implementation; sonar tactical decision aids; training; and engineering measurement and evaluation. Since inception, ARL:UT has been an integral part of the APB process as well as AN/BQQ-10 sonar modernization. ARL:UT efforts for the Submarine Force are crucial to maintaining operational advantage.

### USAA

*Board Member*  
*John Bird*  
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[https://www.usaa.com/inet/wc/about\\_usaa\\_main?wa\\_ref=pub\\_subglobal\\_footer\\_about\\_usaa\\_page](https://www.usaa.com/inet/wc/about_usaa_main?wa_ref=pub_subglobal_footer_about_usaa_page)  
**Website:**  
www.usaa.com

Multiple moves; tight schedules; deployments and homecomings and numerous other challenges of military life. USAA understands and knows what it means to serve. We were founded by military members to serve the military community, and for over 95 years enhancing military lives has been the sole focus of our organization. USAA offers more benefits for active duty military than any other major financial services provider. Visit usaa.com or call 800-531-USAA to discover them today.

### UTC Aerospace Systems

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Proven provider of products and services to global defense and commercial markets that enable mission success above and below the sea, in space, in the air, and on the ground. Manufactures products providing actionable intelligence through surveillance and reconnaissance solutions; products for small unmanned airborne systems; state-of-the-art Shortwave Infrared (SWIR) products to support warfighters; and environmental control and life support systems that enable humans to safely operate in space and under the sea. Long-time leader in development, testing, and manufacturing of high performance marine compos-



ite structures, rubber, and urethane products providing superior quality and longevity with reduced maintenance.

### **VAACO**

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For 60 years, VACCO has been serving the defense, space and commercial markets with extensive engineering experience and continuous collaboration. From the unforgiving conditions of the deep seas to the demanding elements of deep space, VACCO supports many of the world's most critical programs and platforms for aircraft, filtration, navy and space.

### **VLP Financial Advisors**

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VLP Financial Advisors is a long-standing Naval Submarine League sponsor and the asset manager for NSL's Legacy Fund. They provide sophisticated investment solutions based on individual situations, specific needs, priorities, and circumstances. Their team of skilled Advisors act as fiduciaries, putting client's needs first. VLP is a great resource for all of your personal financial services, with extensive experience in financial planning, investment selection, insurance analysis, and military pension planning.

### **Westland Technologies**

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Westland Technologies is a wholly owned subsidiary of ESCO Technologies, Inc. (NYSE: ESE) in Modesto, California. Today, Westland Technologies serves customers and national defense needs from a 135,000 sq. ft. facility, which includes a factory, offices, laboratory space and warehousing. They provide rubber and urethane based products supporting external and internal submarine applications. They work with over 250 active rubber and urethane formulations, representing the full spectrum of polymers for the most demanding applications.

### **Xator Corporation**

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Xator Corporation is a trusted provider of mission-focused C4ISR solutions addressing National Security & Intelligence, Tactical Intelligence, Critical Infrastructure Protection, and Training for U.S. Government clients at home and abroad. As a committed and dynamic partner, Xator solves operational challenges with innovative and expeditionary approaches to intelligence, analysis, engineering, systems integration, strategic management, and organization-specific training.

## CORPORATE MEMBER SPOTLIGHT

### MS. STAR DILLARD CEPEDA, INC.

Recently, the Executive Director of the NSL had a conversation with Ms. Star Dillard, the CEO of CEPEDA, a 5-year corporate member. Following is a transcript of their discussion. If other NSL Corporate Members would be interested in a similar conversation, please contact [execdirector@navalsubleague.org](mailto:execdirector@navalsubleague.org).

**Oliver:** How did CEPEDA get started and how have you been associated with it?

**Dillard:** CEPEDA was founded in 1977 by Ira Banta, who had previous experience manufacturing carbon dioxide (CO<sub>2</sub>) scrubbers. Under Ira's management, CEPEDA began providing refurbishment services for all classes of submarines. In the early 1980s, CEPEDA began to refurbish the carbon monoxide-hydrogen (CO/H<sub>2</sub>) burners (eventually buying out a competitor for burner manufacturing). CEPEDA then began to manufacture both scrubbers and burners for new procurements and after a change in ownership in 1994 also began to participate in the Advanced Equipment Repair Program, i.e. performing onboard inspections and refurbishment of equipment to save the Navy from cutting the hull to remove our air purification equipment for repairs, and thus saving them considerable funds.

I started in 1999 as the Controller. I became the President in 2008 during the transition of buying out the then-current three owners and establishing CEPEDA as an ESOP (Employee Stock Ownership Plan). I have encouraged growth and diversification of other critical equipment.

CEPEDA now is the sole source producer of CO<sub>2</sub> Scrubbers, CO/H<sub>2</sub> Burners, Hoppers, Demineralizers, Missile Dehumidification and Drying Machine, and automatic high-pressure air dehydrators. We also bid competitively on Level 1 valve bonnets and bodies, forward and aft operating rods, piston rods, valve stems, actuators, and non-Level-1 candle furnaces, fire extinguisher brackets, fire extinguishing system compo-



nents, and accumulator contents indicators.

Additionally, we offer design, qualification, and acoustic testing services and participate in Small Business Innovation Research contracts. We are currently designing and qualifying a chlorine generator for the Trident Class boats.

CEPEDA has a supportive management team and owner-employees who love supporting the U.S. Navy!

**Oliver:** How did you get started as a submarine supplier?

**Dillard:** We have always been a 100% Navy contractor. We now support the Navy with direct contracts from NAVSUP and Navy contractors, such as Newport News, Electric Boat, Raytheon, Hunt Valve, Kidde Fenwal, FabForm, and British MOD via TPG Maritime Limited.

**Oliver:** What percentage of your business would you say is submarine-related?

**Dillard:** 100%

**Oliver:** With the prospects of a growing demand for submarine products to support more submarine construction, how do you feel about CEPEDA's preparations to meet the growing demand?

**Dillard:** CEPEDA is prepared to offer more manufacturing and engineering services to the Navy and shipyards. CEPEDA offers Navy qualified welding, machining, fabrication, design, qualification, and testing services for mission critical equipment. We have excess capacity due to some obsolescence in the units we have historically manufactured for new procurements. We have also begun to explore our supplier base to determine where they have excess capacity to support the shipyards. This task is on hold until I have demand details from the shipyards. We have implemented an ERP system and upgraded our design tools. We have strengthened our Quality department, by strengthening the management of both internal processes and material and external suppliers.



**Oliver:** Do you have the information that you need to grow your business and to support the growing demand on the supplier base?

**Dillard:** No, I do not feel I have been successful in retrieving information from the shipyards regarding what type of products they are interested in outsourcing. I have let both shipyards know that we have full Board of Directors (BOD) and bank financing support to purchase real property or equipment to help support the shipyards during this Virginia Class Block V and Columbia Block I procurement. We have shared our capabilities with the shipyards and let them know we have additional capacity to assist them. We are poised to act and are only waiting for their communication. I hope they respond early enough to allow us adequate preparation time to support them.

**Oliver:** Do you have any ideas about any actions that could be taken that would enable you and other suppliers to be better able to respond to the growing market demands?

**Dillard:** Yes, I believe that the shipyards could use some of the \$1.5 million requested from Congress for supplier development to set up a portal, much like the Navy uses NECO (Navy Electronic Commerce Online) at <https://www.neco.navy.mil> and FBO (FedBizOpps.gov) to share joint shipyard demand with qualified approved suppliers. I envision this portal would be a password protected portal where approved suppliers could see both shipyards' demand. Each supplier knows their own capacity and capabilities, while the shipyards only know their supplier base in part. The shipyards know their own demand, but the suppliers don't have access to that demand information for quoting or planning purposes.

Advantages to the shipyards of using a NECO/FBO type system should include:

- Communication to all approved suppliers as a place to distribute RFQs, current and long-term demand, and offer access to drawings (with the exception of confidential or NOFORN).
- Exploiting existing approved suppliers for additional capacity or capabilities without the time and expense of visiting each supplier's location.



- Additional awards to existing suppliers will aid in decreasing overheads and lowering overall cost to the shipyards.
- Investing/growing the existing supplier base contributes to new hires and potential to lower the standard labor rates and overall cost to the shipyards.
  - Utilizing the existing supplier base lessens the risks to the shipyards' quality and schedule since existing suppliers understand contractual requirements and the necessity of maintaining the shipbuilding schedule.
  - Utilizing the existing supplier base lowers the risk of a supplier running out of work which, in the case of a 100% Navy supplier, or/and especially a sole source supplier, is a risk to the shipbuilders and the Navy.
    - Competitive bids from known suppliers - a portal should increase the quantity of competitive bids and aid in cost reductions
    - Opportunity to offer RFQs as small business set-asides to aid in meeting FAR small business plan requirements
- Advantages to suppliers would include:
  - Opportunity to offer additional services and capabilities to the shipyards
  - Opportunity to view the shipyard demand and plan for equipment or real property acquisitions to prepare to meet future new procurement demand.
  - Opportunity to secure more work which enables 100% Navy suppliers to grow their workforce and to retain skilled workers.

**Oliver:** As a Corporate Member of the NSL for the last 5 years what have been the most important features of membership to you?

**Dillard:** The conferences the NSL provides in the spring and fall, where Admirals, shipbuilder's representatives, government officials, etc. share information and presentations regarding upcoming procurement, budgeting, and shipbuilding plans have been very insightful.

Introductions to other members of NSL - Admirals, suppliers, the League's administrators and Board of Directors have been helpful.

I think this interview and publication will help bring awareness that

suppliers are ready to aid the shipbuilders, but that they need more feedback in order to make decisions and implement preparations. I think having the NSL as a voice and advocate will be helpful.

**Oliver:** How else could the NSL help you and your company?

**Dillard:** Having access to the presentation files from the conferences would be helpful. Is there opportunity to have liaisons or representatives from the SBA at an NSL function?

**Oliver:** We'll be sure to look into that! Thank you.



**NAVAL SUBMARINE LEAGUE  
35TH ANNUAL SYMPOSIUM**

**UNITED STATES SUBMARINE FORCE: GETTING FASTER**

**RADM LORIN SELBY, USN**

ADM. LORIN SELBY: Hi, how's everybody doing? It's after lunch, a little after noon, head nods are setting in for some of you. Who's a Houston Astros fan here, anybody? Alright, I'm with you. It's not my team but I want to see them win. After that hurricane I think the town deserves a big win.



I am going to talk to you today about what I do at NAVSEA and how we support the undersea vision that Admiral Tofalo and Admiral Caldwell laid out earlier. I've got a few slides to walk you through some of the things we do at NAVSEA in general, and what I specifically do as SEA 05 or the chief engineer for NAVSEA. I'm pretty much the chief engineer for the Navy, just about every ship, submarine, aircraft carrier and all the associated combat and weapons systems on those ships and submarines throughout the fleet fall under my cognizance. It's a lot of

stuff and it keeps me pretty busy.

Let's talk about NAVSEA. Most of you know who we are. Think about the history. For 220 plus years NAVSEA has been in existence. We've had several names throughout that time, and you can see that on the slide: Board of Naval Commissioners, Bureau of Ships, Bureau of Ordnance, and now NAVSEA. But the function really has always been to deliver those ships, those submarines, those aircraft carriers and maintain them when they get to the fleet. That's what we do.



## HISTORY AND HERITAGE OF NAVSEA

**Cornerstone of the Navy for over 220 years**

- 1794

- Naval Act of 1794 established a permanent standing naval force
  - Joshua Humphreys and Commodore John Barry charged with overseeing the design and construction of the original six frigates
- 1798

- Navy Department established to provide a government organization structure to the U.S. Navy
- 1815 to 1842

- Board of Naval Commissioners
- 1842 to 1940

- Bureau system established: Bureau of Construction and Repair & Bureau of Ordnance among original 5 Bureaus
- 1940 to 1966

- Bureau of Ships estab from merger of Construction & Repair and Engineering
  - Bureau of Naval Weapons estab from merger of Ordnance & Aeronautics
- 1966 to 1974

- Bureau of Ships → Naval Ship Systems Command
  - Bureau of Naval Weapons → Naval Ordnance Systems Command
- Naval Sea Systems Command established from merger of Naval Ship and Naval Ordnance Systems Commands













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If you look over the history of NAVSEA, think about the transitions that have happened in the Navy during that time period. We went from the days of sail to the days of steam, coal-fired steam to oil-fired steam to nuclear powered steam. We went from the days of shooting cannonballs to shooting projectiles in rifled barrels that you could shoot 25-plus miles down range with accuracy – especially when you brought in the radars that we integrated with the fire control system.

Think about the transition we made when it comes to the weapons systems when we made the leap to missiles. Think of the Tartar, Terrier, and Talos missile days when we were shooting missiles hundreds

of miles. We were intercepting contacts in the air using Aegis Combat System integrated with the missile system to tie the fire control system to that weapon as it intercepts and takes out that threat. That's a pretty amazing capability.

That's a lot of innovation and advances throughout that time period, and we are still doing that today. Think of the rail gun. Think of lasers. Those are technologies that we're still working on. We're trying to go to the cutting edge with these technologies and bring them to the force not 20 years from now, but today.

Think of the laser on Ponce that has been deployed to the Gulf for the last several years - very successful operations. Or the rail gun that we continue to test at Dahlgren Virginia. We've actually got it on the River Range now shooting it down river. At some point we need to take it out to White Sands, New Mexico to validate it's capability at range. This is all amazing technology that we're working with today and I'm going to talk to you a little bit about some of that.

Like any organization, we've got a strategic framework. What this basically says is our mission is to deliver ships and submarines to the fleet combat ready, on time and on cost. In fact, we've got three key areas of focus. One is on-time delivery of ships and submarines. The second one is developing a culture of affordability. We've got to do that smart-



## NAVSEA STRATEGIC FRAMEWORK



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ly being conscious of the taxpayers' money and finding new innovative ways to do business to try and do it at less cost and to get more bang for the buck. The third focus is cyber security.

I think Admiral Tofalo spoke to that. It's a huge focus for us. Cyber security is not just your IT network. That's really SPAWAR's mission. My mission is focused more on those machinery control systems, the hull mechanical and electrical systems, and then the combat systems on those ships and submarines. Those are the ones we're going after.



## COMMAND OVERVIEW



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So how do you do this? Well, you do it with a lot of dedicated Americans: roughly 75,000 men and women. Over the course of the year, about \$45 billion comes in and out through various accounts to do those missions. Sixty-five ACAT programs across five PEO and roughly 100 CNO availabilities during that timeframe, and that's year after year after year we continue to do that.

Where are we? We're actually all over the globe. Obviously a heavy presence is across the United States. You know the four Naval Shipyards, we've got warfare centers across the country. I command the Surface Warfare Centers, there's eight centers right there alone. Then there are the regional maintenance centers.

We've also got overseas presence in places like Bahrain and Rota, where we do maintenance overseas on forward deployed ships and sub-

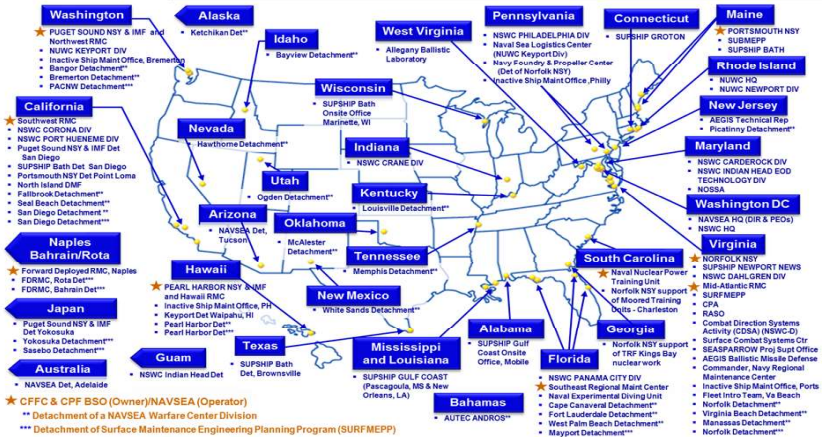
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marines. When there's a problem anywhere in the world - we can send a team – we'll send a team to the ship, and we do that routinely.



## NAVSEA ENTERPRISE – WHERE WE ARE



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**NAVSEA SEA 05**  
 NAVAL SEA SYSTEMS COMMAND  
**Naval Systems Engineering Directorate**

**SEA 05H**: Aegis Combat System

**SEA 05S**: Additive Manufacturing

**SEA 05D**: Advanced Div System

**SEA 05P**: Undersea Warfare Systems Engineering

**SEA 05N**: EMALS Testing

**SEA 05E**: Hybrid Electric Drive

**SEA 05Z**: Risk Analysis

**SEA 05W**: Combat Identification Systems

**SEA 05V**: MK8 MOD1 SEAL Delivery Vehicle

**SEA 05Q**: CYBERSECURITY

**05U**: Risk Analysis

What is SEA 05? Admiral Donnelly spoke to the fact that the chief engineer is the engineering director for the Navy. What does that really mean?



If you look at the pictorial, the top left, 05H is my code that deals with combat systems, so Aegis Combat Systems and Ship Self Defense Systems that are on carriers and our big deck amphibs.

Next there's 05S, that's my standards group. Think of publications, NSTMs, tech manuals. And think about a new technology like additive manufacturing. How do we write the book on that? How do we develop the standards to ensure those components are going to be safe to operate on our ships and our submarines? How do we actually get to a point where we can print a sub-safe component? We're going to get there.

Some of the ships are actually pushing pretty hard in this area. Some of our vendors are doing that as well. We're looking hard at that and we're developing the standards. We're working with OPNAV to develop a funding line to help us develop those standards for additive manufacturing.

Just think about this, we've had literally thousands of years of experience when it comes to metals: molten metals, machining metals, forging metals; additive manufacturing not so much. We're in maybe the second decade of using this new technology. Think of all the stress-strain curves we have to generate and the Charpy v-notch testing! We have to do those tests with all types of materials and all types of 3-D printers. We've got to qualify all of those materials and all of those different printers, so we're working through a way to do that right now at NAVSEA 05, teaming with NAVAIR and others. It's really a non-trivial problem!

05D is my ship design group. This is surface ship design, think of the folks who do all the design work for the next frigate and the next future surface combatant. They've got all the naval architects for the Navy, working at SEA 05, or at the Naval Surface Warfare Center Carderock.

On the top right, this is my newest group, 05Q. We stood this up in the summer of 2016. This is my cyber security group. So again, you can see the importance of the mission. This group is looking to protect all machinery control systems for all hull mechanical and electrical systems on Navy ships and submarines, as well as the combat systems. The IT communications systems are handled by SPAWAR. But we have a very close partnership with SPAWAR as we handle the tech authority for these components.



Going to the middle left, we've got 05T. This is the technology group, so this is the group I spoke about a minute ago that does all of the advanced technologies: lasers, rail guns; I'll talk about Big Data here at the end, but Big Data, artificial intelligence, and autonomy are new areas we are focusing on. We've also got a lot of work here on additive manufacturing. So they're working with 05S kind of working the standards, but also working the hardware piece of that.

To the right of that you've got 05W. These are weapons systems associated with surface platforms. Think of missiles. Think of cooperative engagement systems. Those are 05W.

05P in the middle, that's a picture of a full ship shock trial. 05P does everything from shock, structures, to waste disposal systems. Think of the plasma arc waste disposal system on the *Ford*. They handle many of the different systems associated with environmental compliance, as well as fire protection, so fire-fighting systems, fire detection systems, that's 05P. It's actually a pretty heavy lift. They do a lot of hard work for NAVSEA when it comes to new designs, and many in-service issues in the fleet.

05N, the next one on the right, that's undersea systems, so think of your combat systems on the submarine, weapons systems on the submarine. It's your undersea warfare systems.

05V, the far right in the middle, that's my aircraft carrier group. I've got a whole group dedicated to aircraft carriers, both the in-service aspects of it as well as the new design aspects of it. So we were heavily engaged over the past several years in getting *Ford* delivered. It's a lot of hard work, working closely with Naval Reactors, as well as the rest of NAVSEA and the ship builder, to get a ship like *Ford* to sea for the first time.

I was fortunate enough to be on that ship for its delivery, along with Admiral Caldwell, and it's an amazing capability. We've now actually gotten close to 90 catapult shots with the EMALs system, the Electro-Magnetic Aircraft Launch system, as well as aircraft traps with the Advanced Arresting Gear, the AAG. We've been doing initially shake-down of *Ford* for the last several months, so a lot of great work, a lot of great progress bringing all of those new systems online.

To the bottom left you've got two things there. One is 05M. All

those Navy SEALs standing in front of that SEAL delivery vehicle, so they do mine warfare as well as special operating force work. So again, SEAL delivery vehicles, shallow water combat submersibles, SWCS, as well as your traditional mine hunting systems, whether it's MCMs or the new unmanned systems. That's all mine hunting.

Below that at the bottom left is 05C. That's my cost estimating group. This is a NAVSEA group that does all of the Navy's -- first cost estimates come out of 05C before they go to the Pentagon and CAPE and others take them. They start at NAVSEA. So we work very closely with program offices, with the shipbuilders, keeping track of all the new cost factors that go into the new construction of a ship or weapons system.

Then there's 05E, that's a picture of an ejection seat, so it's energetics. We work very closely with Indian Head, which is the Surface Warfare Center in Indian Head, Maryland where we actually develop and manufacture cartridge actuating devices, which actually eject things like ejection seats out of airplanes, and energetics.

The bottom center is 05Z, this is my Marine Engineering Group. This group does everything from electrical distribution, electrical generation, steam systems, gas turbines, diesel engines, that's all in 05Z. They're also the group that I've got working very closely with 05T on some of those advanced analytics that I'll talk about in one of my last slides.

And the bottom right, last but not least, is 05U, the undersea warfare branch. This room is probably the most familiar with that group. Again, it's everything from submarine design, submarine operations, in-service work, that's 05U.

What's the alignment with the PEOs? I'm going to talk to this. If you think of those different codes I talked to, each PEO is mapped to a different part of my technical pyramid. PEO ships works heavily with 05D. That's those ship designers, the same with PEO LCS, the Littoral Combat Ships. They work closely with 05D and 05H for the combat systems: AEGIS or SSDS.

The carrier group marries very closely to 05V as well as 05H, because again, carriers have a combat system SSDS. They get other major support from the structures guys in 05P. They do the mine work with the folks in 05M, the warfare systems folks in 05W, and the electrical folks



INDEPENDENT TECHNICAL AUTHORITY  
ENGINEERING RELATIONSHIPS

	SEA 05S (Standards)	SEA 05C (Cost Eng)	SEA 05T (Technology)	Acquisition	New Construction	In-Service Maintenance & Modernization
<b>Ships</b>				  PEO Ships – Trn Ships    PEO LCS	NAVSEA 05D, 05H Matrixed RED Box Support NAVSEA 05M, 05P, 05W, 05Z	SURFMPEP/SEA21/PMS400 & 470 NAVSEA 05D, 05H Matrixed RED Box Support NAVSEA 05M, 05P, 05W, 05Z Private (Contract) Shipyards
<b>Carriers</b>				 PEO Carriers – Team Carriers	NAVSEA 05V, 05H Matrixed RED Box Support NAVSEA 05P, 05W, 05Z	Carrier Planning Activity (CPA) NAVSEA 05V, 05H Matrixed RED Box Support NAVSEA 05P, 05W, 05Z Public (Navy) Shipyards
<b>Subs</b>				 PEO Submarines – Team Submarine	NAVSEA 05U, 05H Matrixed RED Box Support NAVSEA 05N, 05P, 05Z	SUBMEPP NAVSEA 05U, 05H Matrixed RED Box Support NAVSEA 05N, 05P, 05Z Public (Navy) Shipyards
<b>Warfare Systems (C5I)</b>				   PMS 340 PMS 408 PEO C4I Integrated Warfare Systems	NAVSEA 05H Matrixed RED Box Support NAVSEA 05M, 05P, 05N, 05W, 05Z	PEO IWS & C4I NAVSEA 05H Matrixed RED Box Support NAVSEA 05M, 05P, 05N, 05W, 05Z

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in 05Z.

The next one down is subs, so 05U is heavily linked to them. Submarine combat systems are aligned to 05N. And at the bottom, we work closely with 05P on structures, propulsor design, and firefighting systems, for example.

I talked a lot about tech authority. One of the things that I have which is granted to me by the secretary of the Navy via my boss Admiral Moore, COMNAVSEA, is tech authority for the systems under my cognizance. So to talk about tech authority, it's often better to talk about what happens when you don't have tech authority.

There's two examples here. The first example is *Columbia* but *Challenger* falls in the same category.

NASA has a lot of very bright engineers, and they work with cutting edge technology. But what they did not have was a dedicated branch that had what I'll call independent tech authority. That's the ability to identify a technical issue or a technical problem and be able to basically throw a red card and say, no, we're going to stop. We're not going to proceed.

They didn't have that structure. There were plenty of people at NASA that knew what would happen if you took an O-ring down below 32 degrees and froze it, you were going to get blow-by: That's what



## ROLE OF TECHNICAL AUTHORITY

Loss of NASA Columbia (OV-102)  
Mission STS-107  
2003



Near Loss of USS Dolphin (AGSS-555)  
2002



**"One of the most difficult COLUMBIA Accident Investigation Board organizational recommendations is that we develop an independent technical authority to assure excellence."**

Sean O'Keefe, NASA Administrator

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happened to *Challenger*. On *Columbia* you had foam from the fuel tank hit the wings of the shuttle on launch. Again there were engineers who knew that damage to the leading edge of the shuttles wings would happen and that it was only a matter of time before a critical failure happened. Again, they didn't have the avenue or the venue to say, no, and stop the launch.

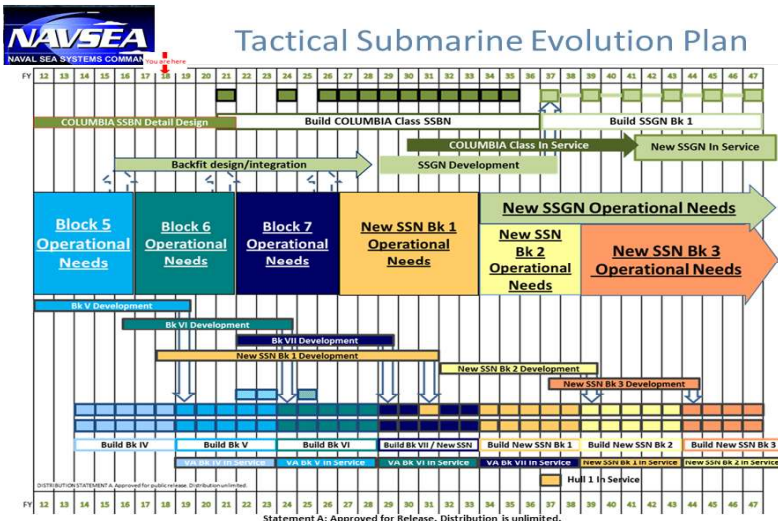
They were faced with pressure – the pressure on the other side was the operational pressure to get the shuttle into space, the cost pressure of what it takes to fuel the shuttle and then de-fuel it to wait for another launch day. Those pressures over-rode the technical. We don't want to do that.

We had a similar issue on *Dolphin*. There was a waterfront decision to change an O-ring on a door gasket. It was not vetted by headquarters. Because of that, they had a flooding event – they flooded out part of the ship. It was nearly catastrophic. It was a near miss.

We don't want to go there. So we very tightly hold our tech authority really kind of close to the vest at NAVSEA. That gives me the authority to, if I deem something unsafe, or that there is too much risk, I can say no, and I have said no. That's my job, to be looking at these technical issues with an objective view – with an independent view. We get the data, the facts, the objective quality evidence and make the assessment



whether something is safe or not to operate. That’s what we do. That’s what this tech authority is and that’s a really important part of what I do for the Navy.



We’re going to transition to some advanced technologies and where we’re going in the future. This is the TSEP, the Tactical Submarine Evolution Plan that some previous speakers spoke to. This lays out kind of – what I look at is opportunities for inserting technologies. So if you look at Block V, VI, VII and beyond, these are opportunities for us to actually insert new capabilities and technologies into the submarine force.

The first one coming is Block V. This is going to be really kind of game changing. For me, when I was at N87 back then in 2007 and ’08, I left there to come to NAVSEA for my first NAVSEA tour, this was just an idea – not even a power point yet! From that idea we pushed this thing and we got support across Navy and DOD and on the Hill, and here we are. We started the design work and we are now, as Admiral Caldwell spoke earlier, going to start construction in 2019, delivering it in 2024.

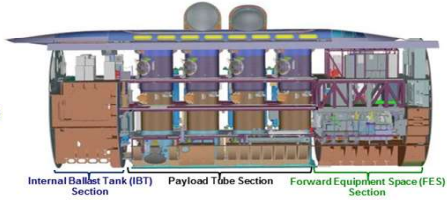
This is going to be a game changing capability. It brings us four additional tubes, seven missiles per tube. And it’s not just adding a hull section with missiles. We had to bring in an integrated ballast tank as well as another equipment space. So this is very carefully crafted for weight and stability, and we honed in on about an 87-foot length as the

right length to do this. So as we said earlier, this is actually underway now and getting ready for a 2019 start. I'm pretty excited.



## VIRGINIA CLASS BLOCK V OVERVIEW

VIRGINIA Payload Module



**Block V Increases Undersea Influence Effects and are Technologically Ready for BLK V Insertion**

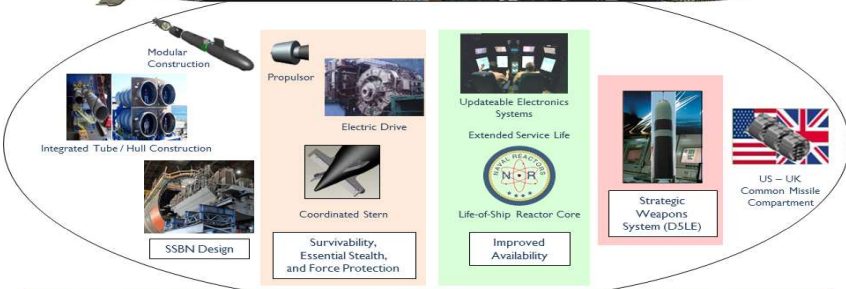
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## A HOLISTIC PLAN TO DELIVER COLUMBIA

*"Aligned Execution of Multiple Discrete Elements"*



**Ship, Propulsion Plant, and SWS Development are Synchronized to Deliver in 2031 No Margin for Delay**

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*Columbia*, of course, a lot of focus on this. This is the team that's working *Columbia*. This is an impressive team. Obviously you've got NAVSEA, Naval Reactors, SEA 05, PEO Submarines, PMS-397, heavi-



ly engaged in this. We've got SSP engaged in this too with the strategic weapons system, with the missile tubes, a lot of amazing capabilities coming. This is well underway. This is a big part of SEA 05's job, getting the ship ready to go to sea at the end of 2031.

And then SSNS, I alluded to that on the TSEP slide earlier. One of the things we are looking at really hard in NAVSEA is set-based design. Who out here has heard of set-based design? Maybe a quarter of you.

Think of the way we design ships and submarines traditionally. You basically come up with a low, medium and high mix of options. Because we did a lot of this work manually or even with computers, somewhat in stovepipes, you had to, very early on, settle on what the low-end capability would be, then the medium and the high. Then you would iterate on those until you came up with a solution that you thought could meet the requirements and also do it in an affordable way.

Today with the capabilities we have with computing power and the ability to actually run models in parallel with tools like Model Builder, we can be running a hydro model and weight and stability model, and maybe a fuel model. We can run all these models in parallel. With that capability we no longer have to down select to two or three options early. You can keep the design space open for a much longer period of time. You actually come up with thousands of iterations of possible solutions, really tens of thousands!

What you very quickly find is that there are knees in the curve that you can easily find where the cost breaks are. You can easily find where the speed break is, the range breaks are, and those really help you set the requirements properly as well as very tightly couple the model with a cost model to come up with a high-fidelity cost model upfront. Again, oftentimes you do this kind of low, medium, high mix and may have three pretty good models, but you're missing a lot of trade space in the middle.

So we're doing a lot of work in this area on the surface side. It's time to bring this to the submarine side, and I think my EB friends and HII friends are all totally in agreement here. SSN(X) is definitely the place to bring this on, if not before.

We talked about getting off board. This is another huge area that NAVSEA is working hard on. Captain John Rucker from of PMS-406





## SSNX-SET-BASED APPROACH

- An aggressive development timeline and large trade space for future VIRGINIA Blocks and SSNX necessitate set-based approach
  - Requirements Analysis
  - Submarine and Combat System Concept Design
- Pre-Milestone A decisions are very influential; the majority of costs are committed well before they are incurred
- Make the right decisions the first time by methodically understanding tradeoffs prior to commitment
- Expand use of model based design and engineering

**Outcome: Define Cost vs. Capability**

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## UNMANNED SYSTEMS



Mine Hunting Units (MHU)



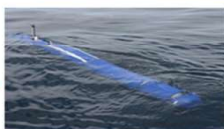
Unmanned Influence Sweep System (UISS)



Snakehead LDUUV



Knifefish UUV



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has now got all these systems: unmanned surface vessels as well as unmanned underwater vehicles.

A lot of great work has been going on over the past several years – if I go back to my N87 days when we started some of these programs - back in the late 2009-2010 timeframe - a lot of work has been going on in



this area. We are now actually testing a lot of systems. We're learning a great deal about their endurance, their autonomy, and we're finding some things we need to focus on. Some of those areas are right here.



## UNMANNED TECHNOLOGY ENABLERS

- Endurance
  - Improved reliability & safety
  - Increased endurance & range
  - Support additional & more capable sensors
- Autonomy & Precision Navigation
  - Increased levels of autonomy & decision making
  - Increased accuracy & reliability
- Command, Control, and Communications (C<sup>3</sup>)
  - Safely, autonomously & reliably launch and recover
  - Improved Command, Control, and Communications
- Payloads & Sensors (ISR, Comms, etc.)
  - Increased capacity for sensors, payloads & systems
  - Increased capability, both individual & with other platforms
- Platform Integration (L&R, etc.)
  - Increased capability to L&R
  - Increased coordination with host platforms

**Increasing the Maturity of Critical Technologies is Integral to Success**

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Endurance: it's no surprise that batteries continue to be a concern for us after the ASDS fire back in 2008. We've done a lot of work in that area to try and mitigate those risks and finding ways to prevent fire propagation between cells, which is one of the biggest concerns we have. If you lose one cell and it propagates throughout the entire battery that can be a catastrophic loss of the vehicle and maybe the platform that carries it. So we're working hard to find ways to prevent that propagation. We're also looking at things like fuel cells.

Autonomy and precision navigation: If we're going to disconnect from the host platform, whether it's a submarine, a surface ship or even the pier, you've got to have a great deal of autonomy as well as navigation capability to get you where you're intending to go as well as to get you back, if not to the location it's launched from to some pre-determined location where you can recover the vehicle.

Command and control and communications, how do you keep in touch with this vehicle when it's off-board? Is it going to go to periscope depth once in a while to 'plug in'? Is it going to have a fiber connected

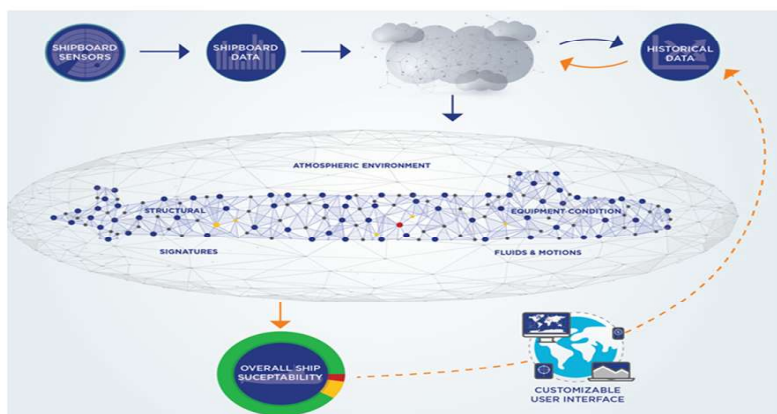
to a host platform? Is it going to have some bottom node it talks to or plugs into? These are things we've got to work through.

Payloads and sensors: The vehicle is great but it's really only a truck used to carry a payload, so we're looking at innovations for the payloads on all of these vehicles. So there's a lot of parallel work with sensors and different capabilities that can be integrated with these vehicles.

And there's the interfaces to the host platform. So again, it might be an amphib, it might be a submarine, it might be a pier in Guam, but you've got to figure out how you're going to work those interfaces. Whatever the launch and recovery vehicle is, you've got to find a way to get the vehicle off and on its way and then get it back on the host platform. And yes, even in heavy sea states - that's not a trivial evolution.



## NAVY DIGITAL TWIN FRAMEWORK CONCEPT



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Earlier I talked about what I've got SEA O5T and O5Z working on. One really exciting area is Big Data. Who has heard of a digital twin? You can't swing a dead cat without hearing about it. GE, Siemens and many other big companies are there talking about this. And there are a lot of small companies as talking about it as well.

The concept is that you model a component, let's say a gas turbine. So you model that gas turbine, using physics and science – you know  $PV=nRT$ ,  $F=ma$ , etc. You model that component and you figure out how



it's supposed to work when everything goes perfectly. Then you instrument and add sensors to the real component. You're collecting pressure data, flow data, fuel data, altitude data for a jet airplane, and you then marry the real data from the sensors to the perfect data from the model. So you're running this model in the virtual world and you're comparing it to the real component. Over time you look for divergence between the two - and if you see divergence you go start asking the questions of why. Is it because the altitude is not what we had predicted? Is it because there's some problem with the fuel pump? Is it some O-ring? Is it some component that is potentially failing?

Those are things you're going to try to figure out. We think we can do this for a lot of components: diesels, turbines, pumps, valves, high pressure air compressors. The list probably goes on and on. NAVSEA has several pilot projects we are working now and we're actually providing data from certain surface ship components.

So we're starting with our destroyers and cruisers and we're providing diesel data, gas turbine data and reduction gear data. We're allowing teams to apply their analytics to the data to see if they can actually predict the things we know have happened. Because we are giving them historical data, we know the answer and we give this data to them and see if they can find something ahead of the event.

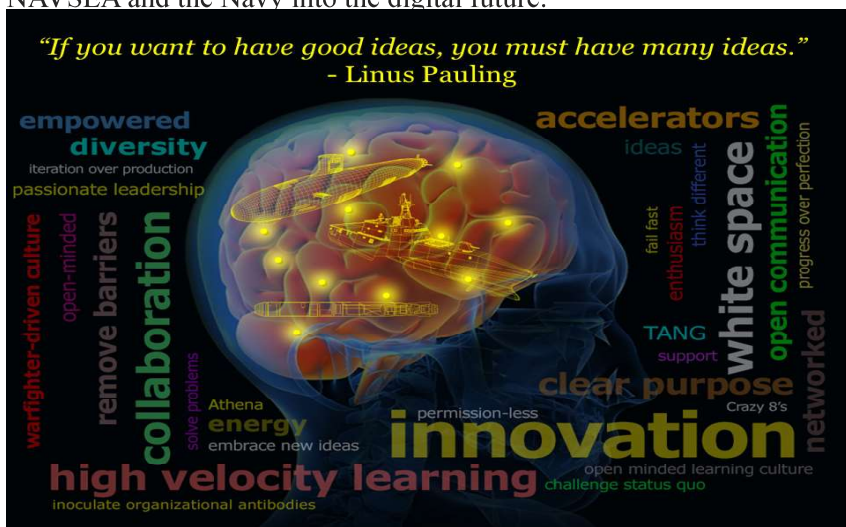
So far, it's promising. We're getting some interesting results. We're going to do this for about another year until sometime next summer or fall, and then we're going to converge on a solution. Then we're going to go off and find ways to apply these analytics. Initially we're going to do the destroyers, maybe LCS, and then we're going to figure out, how does that apply to a submarine?

There's huge promise here. If you talk to the airlines, you talk to companies like GE, they've shown us data on savings, fuel savings. They've found that they can actually help the airlines operate their planes more efficiently, selecting altitudes, selecting routes based on headwinds and other things, based on the way the components are operating, not just on the physics of flying, but how the actual component operates in those environments.

So this is actually, I think, pretty exciting stuff. When you think about the Big Data implications of this, I think this has huge potential

savings. My goal is really providing operational availability back to the fleet. How do we operate ships or submarines or aircraft carriers, and all the components on those vessels more optimally to ensure we can operate those ships longer and keep them at sea as needed by their commanders? That's what we want to get to.

So then when you do maintenance, you're actually coming in with a work package which you generate based on the data coming from these different analytic tools to help us optimize those availabilities so when you come into port you optimize what you do in port. Instead of doing maintenance every six months because that's what the average has been over the last 20 years for that component, we're going to do it based on what that component needs based on the data we're getting from that exact component on that exact ship. So it may not be six months, it might be 12 months for that one. It may be three months, but we're going to find out. That's the goal. So that's where we're trying to go as we push NAVSEA and the Navy into the digital future.



That's what I had prepared. This is my get off the stage slide. I'd really like to entertain any questions you've got on what we're doing or anything I've put out here today. Thank you.

(Applause).



**NAVAL SUBMARINE LEAGUE  
35TH ANNUAL SYMPOSIUM**

**UNITED STATES SUBMARINE FORCE: GETTING FASTER**

**CAPT BRIAN DAVIES, USN  
PERS-42**

Good afternoon, ladies and gentlemen. I'd like to thank Admiral Donnelly for that kind introduction. It's always difficult to often give community status briefs because you have many of your constituents in the room and you sometimes have spouses in the room, so I'm hoping this in general, based on the fact that most of you are in civilian clothes, will be a little less contentious than some of the ones I go to.

Before I start I'd like to thank – I don't know if Admiral Padgett is still here, but he sent me some tickets for the Navy-Memphis game a couple of weekends ago. I don't know who the smarter person was, but it was me that was sitting in a 105-degree temperature in Memphis watching Navy turn the football over five times. I'm sure he was in some nice air conditioning.

I do have to say it's a real pleasure to speak to the Naval Submarine League because although you may say, hey Brian, you're pretty blessed to have two tours in Memphis, Tennessee, but I look back at my time in San Diego at Squadron 11 pretty fondly. While I was there for my commodore tour, I had the pleasure of interacting extensively with the Naval Submarine League there in the southwest chapter. I think Sam Ward is here in the crowd, and Russ Filbeck, I know was here earlier. But that organization did more than just allow the active duty submariners to get together on a monthly basis and rub elbows with the retirees, the veterans, the leaders from the other forces in the San Diego area. They also did a tremendous amount of work for our families and our deployed Sailors in San Diego.

For example, the Submarine League, whether you know it or not, in San Diego sponsored a Family Day when I had most of my ships deployed. They sponsored every homecoming for the ships that came back, and they took a large part in our scholarship function, raising about

double what historically had been raised in San Diego before they took part. So I just want to say thank you for all the Submarine League has done, as an active duty Sailor, and I look forward to continuing my relationship with the League as I embark in my career here at 42.

I've been at PERS-42 since about early August, so I really haven't had a chance to mess anything up yet. But there's a couple of things I want to highlight today. Some of this stuff has not changed since many of you were in uniform. But there are some new initiatives, as you heard some of the Junior Officers up here on the panel talk about earlier, as well as my boss CNP Admiral Burke talk about at lunch.

So we'll talk a little bit roughly about the tour lengths, some of the promotion and career milestones, talk a little bit about some of the talent management, submarine integration, Limited Duty Officers, and we'll end with just a touch on some of the enlisted matters. My goal is not to make anybody here a manpower or personnel expert. If you did it might be a little bit more complicated than what Admiral Jabaley just talked to you about. So we'll give you a quick synopsis of what the Submarine Force looks like in numbers.



## ***Submarine Force Snapshot: Boat Inventory***

### ▪ **Submarine Force in Numbers**

- Submarine Numbers: Total 69 Operational Boats, 88 Crews
- CSL: 22 SSNs, 2 SSGNs, 6 SSBNs
- CSP: 29 SSNs, 2 SSGN, 8 SSBNs
- NEWCON: 7 SSNs
  - 2 per year. Possibly up to 3.
- DECOM/MTS: 5 SSNs



### ▪ **Deployed Boats**

- 10 SSBNs deployed (strategically loaded)
  - 70% of Nation's accountable strategic weapons under New START.
- 10 SSNs deployed on average
- 2 SSGNs deployed on average

### ▪ **OHIO Replacement (ORP): COLUMBIA CLASS**

- #1 Priority: First patrol in October 2030
- Initial Manning in 2024



3

As Admiral Tofalo talked about in his speech yesterday, we pivoted to the Pacific years before President Obama announced that pivot. As you can see right here, that's our laydown in the Pacific right now. At



any one time we have about 10 SSNs and two SSGNs deployed and 10 SSBNs strategically loaded providing up to 70 percent of that strategic weapons load under New START.

As Admiral Jabaley just talked about, we're already starting to look at manning requirements and – whether or not you realize it – we have already assessed the Junior Officers that will be commanding officers of Ohio Replacement. So that's the timeline we're looking at. As Admiral Jabaley talked about, his timeline is 2030-2040. We're there or earlier when we talk about manning.



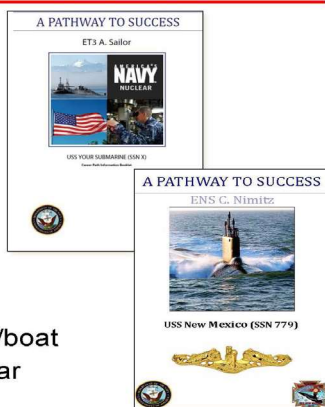
## Submarine Force Snapshot: Manning

### ▪ Enlisted Manning

- Submarine Fit/Fill: 90%/103%
- Nuclear Fit/Fill: 90%/104%
  - Exceeds CNP Fill goal of 98-102%

### ▪ Officer Manning

- Submariners: 3,843
  - Shortfalls at 05 and 06 paygrades
  - YG08 and YG09 missed DH goal
- JO At-Sea Manning: 11.5 officers/boat
- Approximately 400 new 1170s/year



4

I'll give you a quick snapshot of the submarine force overall in manning. I'd say we're very healthy. You had a chance to listen to the Chief of Naval Personnel earlier and a lot of the Junior Officers on the panel, but a quick overview. Enlisted submariners right now, we man about 21,436 Sailors in the Submarine Force. Our ships are manned over 100 percent of the billet demand signal, that's what we call "fill," and we have the right Sailor with the right rank at the right fit about 90 percent of the time, which is really above what the rest of the Navy is able to achieve right now.

On the officer side, our 3,800 submarine officers make up about 15 percent of the unrestricted line, and about seven percent of the total officer corps. So as you've heard Admiral Caldwell and Admiral Tofalo talk



about, we really are a lean force here in the submarine community. We still do have some shortfalls, especially in the control grades, what we call the O4 to O6 level.

So right now, if you look at O5, our authorizations – what Congress allows us to have – is about 316. We currently have 300, not bad, but when you add in all the billets that I'm required to fill that aren't necessarily discretely coded for a submarine, surface, aviator, or SEAL, that puts the deficit up to about 174 commanders.

In the O4 level, we're authorized 636. We have about 606 in inventory right now. When you add those additional not discretely coded billets on top of that, we're down about 165 lieutenant commanders.

At the O6 level we're down about 50 O6s right now. So we do continue to emphasize retention at the mid and high level of the Submarine Force, and I work that on a daily basis in my role in PERS-42. As an aside, we bring about 400 new officers into the Submarine Force every year.

We are retaining our JOs at the right numbers. I'll talk to you a little bit about that in a future slide. At sea, we have an average of 11.5 JOs per ship. If you're in an extended refueling overhaul or you're a deploying boat, you may get a little bit of a plus-up from that, but on average we are programmed for nine and we're filling the submarines with a little over 11 right now.

Look at our career path for the Submarine Force. This doesn't look very different from what you all have seen in the past if you were a submariner. We do offer many different opportunities right now for some JOs, which I'll talk about in a future slide.

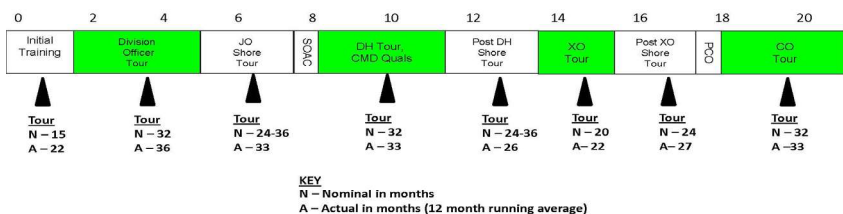
But we did make some modifications to our JO tour length about a year ago where we pulled the opportunity for those Junior Officers to take the Prospective Nuclear Engineering Exam, or PNEO, which is one of our crucible events as a Junior Officer to be qualified as an engineer and serve the Navy in the future, to the left. We did that for several reasons. We wanted to maximize the amount of time that Junior Officers had onboard their submarine after they had completed all of their qualifications, so they could focus on the ship driving and tactical proficiency and the ability to become more proficient at that next level in their submarine career.





## Submarine Officer Career Path Tour Lengths

- Division Officer tour length shifted to 32 months to ensure JOs rotate to shore tour vice separating at MSR
- Tour length management ensures the right population of 1120s are available for each stage of the career path



**Officer tour length management is essential to community health**

5

We have seen a very good return on investment in that area, especially when talking with many of the commanding officers in the Fleet. They’re really taking advantage of that opportunity to have those Junior Officers take that PNEO exam earlier. Sometimes they take it even as soon as 14 months after reporting to the ship, especially if they have prior enlisted experience or they’re a very sharp, hot running JO, as we like to say.

It also provided us another advantage by allowing that officer to take that exam a little earlier. We can look at rolling some of the top performing JOs off of their first submarine tour at about the 32-month point, which is what we’re shooting for right now. That does several things. It allows me to get them to shore duty because, as I tell my commanding officers in the Submarine Force right now, I can guarantee you that a JO that doesn’t go to shore duty is not going to go to Department Head. So we need those JOs to go to shore duty.

I’ll give myself as a personal example. When I finished my first sea tour, I was not quite ready to go off and be a Department Head. I needed a little bit of time away from the ship to experience shore duty and get my family planning in line.

I had some good mentoring and I encourage you to talk about Junior

Officer retention, for those of you that are retired. You still can serve as mentors for many of your former Junior Officers and department heads. I know many of you do that.

I've had periodic mentoring sessions with Admiral Walsh and Admiral Donnelly many times. I'll tell you, when it came time for me to make a decision to go to SOAC (Submarine Officer Advanced Course), it was – since I have the microphone I won't put Admiral Walsh on the spot, I don't know if he's still here, but I can tell a good story.

I'll give you one of two choices and you can figure out how Admiral Walsh handled it with me. The one choice is he kind of put his arms around me, hugged me and tried to convince me to go back to shore duty. The other option was he called me, and he used some flowery language. He said, what are you doing? Why aren't you going back to be a Department Head? I was kind of one of those guys that needed a kick in the butt.

I ended up going back as a Department Head. I use that story as just kind of an anecdote that every Junior Officer is different. In PERS-42, we provide them with many different options when they go to shore duty so that they can make the informed decision as to whether or not they want to go back to be a Department Head.

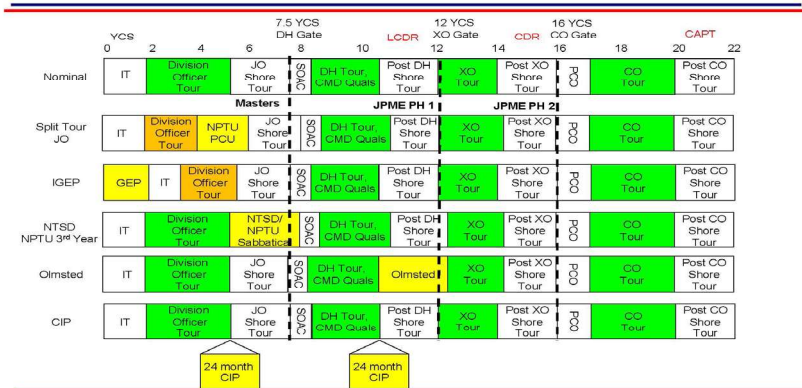
Continuing on in the career path, there are a couple of differences when you go to post-Department Head shore tours, especially if you're a non-engineer-served officer versus an engineer-served officer, because we have to manage the talent on the submarines both at the Executive Officer and Commanding Officer level as far as who has been an engineer-served officer. We do have to maneuver timing around a little bit on some officer shore duties, but all in all, all officers get at least an 18-month shore duty between sea duties unless they opt to go back sooner. Some officers, especially in the Junior Officer world, will get a 36-month shore tour following their JO tour if they follow some of the more unique career paths. I'd also like to end on this slide by saying our Commanding Officer tour lengths have remained relatively constant over the last decade, right at about the 32 to 34 months point. That's compared to our brothers and sisters in the surface community that average about 18 months in their Commanding Officer tours, and aviators that manage about 14 months for their Commanding Officer tours.

Flipping forward to the career paths that I was talking about for JOs that we made flexible, as I alluded to earlier, some Junior Officers have the opportunity to take a 36-month shore tour. That allows us to give them the option to look at unique career opportunities following their first sea tour. Some JOs opt to go to a prototype, and some JOs opt to take the opportunity to go to a pre-commissioning unit.

Those pre-commissioning units, as Admiral Jabaley was talking about earlier, are in Norfolk or Groton. That allows some home port stabilization time for those Junior Officers and allows them to really get in on the ground floor of the building process of those submarines where they really get to know how that submarine is built and operates, so that in the future we can get some return on the investment in that officer when they come back as a Department Head, Executive Officer or Commanding Officer. They really know the Virginia-class down to the keel block.



## Flexible Career Path



**Multiple opportunities for Grad Education and Special Programs  
Significant Flexibility – Early engagement provides greater opportunity**

IGEP (Immediate Graduate Education Program) is another opportunity for intermediate level education. As Admiral Donnelly said, I’m a product of this program and I had the great pleasure of going to the Applied Research Lab at Penn State for two years, and I thoroughly loved that. The JOs that opt to do the nuclear power training unit tours or even some that do the pre-commissioning unit tours, we give them an

opportunity to take what's called a sabbatical, and they can do a third year after they finish their two years of prototype or their 18 months in a pre-commissioning unit, and they can use that to get a Master's degree or to concentrate on their joint professional military education.

We also have Olmsted scholars, and CNP talked about some of these, in limited numbers, but it is a great opportunity. Part of the Sailor 2025 Initiative that CNP mentioned earlier is the Career Intermission Program (CIP). It's small numbers right now, but this program allows an officer to temporarily leave the Navy for family planning purposes. We even have the opportunity to open that up for those that want to take a full two years and get a Master's degree on their own time, to take a step out of their uniform, freeze their lineal number and not have to worry about promotion, and then come back in two years later.

Right now, it's really small numbers for us in the nuclear fleet, both in the surface and submarine world where we have one surface nuke and one submarine officer using the Career Intermission Program. Overall, we have about 20 quotas Navy-wide for the program. I expect it will grow in popularity as Sailor 2025 continues to mature.

Looking at promotion and screening opportunities for our submarine officers, it really is following along historical averages. In general, if you have command of a submarine it gets you to captain. If you're a served Executive Officer, you promote to commander, and if you completed a Department Head tour you promote to lieutenant commander. I will highlight lieutenant commander is generally the toughest cut for us in the Submarine Force, as it is for the other unrestricted line communities.

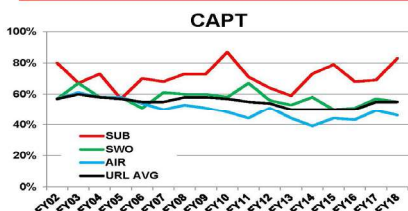
What we have really tried to manage in the distribution world for the Submarine Force is ensure our Junior Officers that are coming off of those shore tours that I described in a previous slide get to their Submarine Officer Advanced Course or the Department Head course at the seven-and-a-half-year point of service. That ensures that those officers have a FITREP as a Department Head when they go before the O4 board. So we're competing against surface officers who are very similar right now in their career path to us. Serving in a Department Head assignment at sea when they're going up for O4, it becomes very competitive. These models are a little bit different, but overall, I would say that we have competed very well in the tough O4 boards.

As part of the recent change to the manpower world, the Chief of Naval Personnel removed what used to be called zone stamps off our records. These zone stamps would notify the board as to what look an officer was on, either for promotion or for selection to Executive Officer or Commanding Officer. Those zone stamps are removed now, and it allows the board to take a look at an officer based on his or her ability and not seniority.

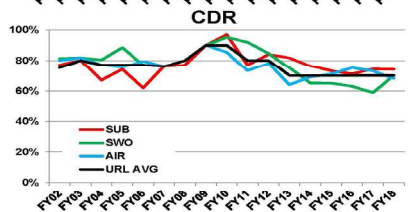
I will highlight, as a result, you may look in the lower right-hand corner of this slide and see that we had a sharp uptick last year in lieutenant commander promotion rates in the Submarine Force. That is because last year we promoted 22 lieutenant commanders below zone, which is unheard of in the Submarine Force. In the previous decade I can count on one hand how many O4s we promoted below zone.



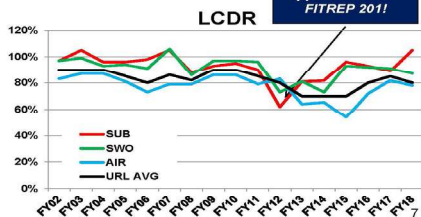
## Promotion & Screening Boards Promotion Opportunity



*Flowpoints shifting right:  
LCDR – 10.6 yrs (FY06 - 9.9)  
CDR – 15.9 yrs (FY06 - 15.8)  
CAPT – 22 yrs (FY06 - 22)*



*Corrective action  
applied in FY12 -  
FITREP 201!*

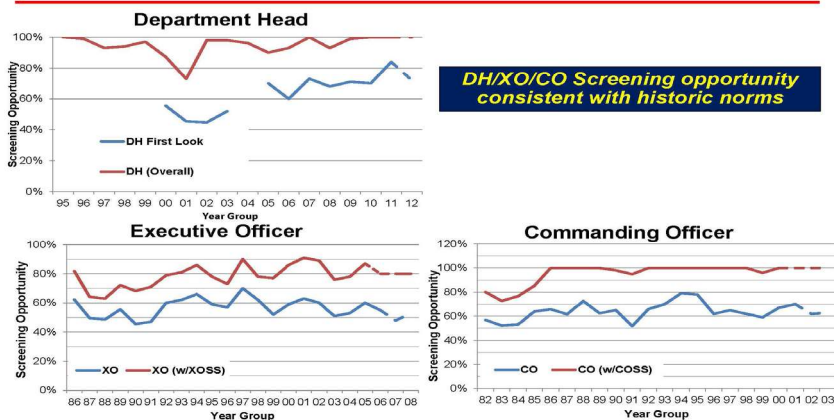


As a comparison, the surface community promoted 15 below zone and the aviators promoted 37 below zone. But if you remember back to my earlier slide, we only make up about 15 percent of the unrestricted line, so 22 compared to even 37 for the aviation community, we're punching above our weight in the Submarine Force when it comes to promotions right now. We are, though, in the end still seeing some of those low points to promotion zones, shifting slightly to the right, most notably at the O4 level.

If I go on to screening board opportunities, these are administrative boards the Submarine Force holds within our own community to look at officer selections for Department Head, Executive Officer and Commanding Officer. We're still doing well and tracking along historical averages. Department Head screening is something that was introduced back in 1995. In most years it's an all qualified category. So if you meet all of the qualification requirements to be a Department Head, in general you have screened Department Head.



## **Promotion & Screening Boards** **DH/XO/CO Screening Opportunity**



We do have a first look and a second look category for Department Heads, but all in all it does not really matter as far as what the assignability of that officer is in the future to Department Head or Executive Officer or Commanding Officer. For XO screening, those officers get a look at their 9, 10 and 11 years of commissioned service, and their promotion rates are 30 percent for their first look, 50 for their second and 20 for their third. The same rates occur for Commanding Officers, they're just at the 14, 15 and 16 years of commissioned service.

You'll see two different lines on those graphs for the Executive Officer and Commanding Officer slides. The red lines show what the promotion rate is if you include both officers that are screened for either Executive Officer or Commanding Officer, and those that are screened for what we call Executive Officer Submarine Support or Commanding



Officer Submarine Support, XOSS or COSS. These are, in essence, officers that are fully qualified to be an Executive Officer or a Commanding Officer, but we just don't have a boat in inventory for them right now.

So we will detail, for example, a COSS officer through the same pipeline that we make our Commanding Officers go through. That includes three months at Naval Reactors, three months at the submarine command course, and then two weeks at our leadership course. They end up serving as a deputy at one of our submarine squadrons basically in a pool available to be called up to serve as the Commanding Officer of a submarine. The same thing applies for the Executive Officers, with the exception that they don't go through the Naval Reactors course.

Overall, historically, we call up about nine of the XOSSs per year and about six of the COSSs per year. So it is a very upwardly mobile path still, and we have many officers that have started as an XO or COSS and then are promoted up from there.



## ***Recent Personnel Initiatives***

- **Nuclear Officer Incentive Pay (NOIP) Continuation Pay (COPAY) renamed to Nuclear Officer Bonus and Incentive Pay (NOBIP) Continuation Bonus (COBO) and raised to \$35,000/yr (from \$30,000) for eligible 1120s.**
- **Prototype/PCU "2-2-2" Option (24 mos JO Tour, 24/18 mos NPTU/PCU, 24 mos shore)**
  - Volunteer during initial pipeline or at sea
  - Previously allowed via policy, but limited takers
- **PNEO Examination 18-20 months onboard**
  - Maintain at least 12 months onboard post-PNEO – "best time" of Division Officer tour
- **Shift Engineer Incentive Pay: \$500/month**
- **PCU Manning Changes**
  - Split tour JOs arrive later
  - Guaranteed no longer than 18 months, in writing from PERS-42
- **Detailer guarantees in writing and additional "sensing points" at early career milestones**
- **Streaming videos – "Ted Talks"**
- **Rotating "Operations Briefs" – SECRET and TOP SECRET VTCs**

***Multiple policies are in place to retain the right talent***

I won't dwell too much on some of these recent personnel initiatives. CNP talked about some of the later ones, but for the Submarine Force in general we raised our bonus to \$35,000 last year. That puts us across the board at \$35,000 for the surface nuclear officers as well as the submarine nuclear officers. We did that, as I talk about in a future slide here, based on a strong economy and some years where we just barely missed reten-



tion at the Junior Officer level.

We've instituted a couple of other of the non-traditional shore duty paths for some of our Junior Officers to allow them, while they're even in the training pipeline, to choose to go to an operational submarine for two years and then go back and either go to a PCUs or prototype, and then go to a shore duty. This allows us to have volunteers for some of those more tough assignments like PCUs and prototype.

Because the shift engineer billets at NPTU's down in Charleston and up in Ballston Spa, New York, have traditionally been difficult ones for us to fill, just based on the nature of rotating shift work for some of our officers on shore duty, we recently started an initiative where those officers receive \$500 extra a month to serve in those billets. We have seen a sharp return on investment in that. As Admiral Tofalo mentioned in his speech, we went the last five Junior Officer slates, for over a year now, without having what we call a red detail or an officer that had a choice of his shore duty that was not in their top 10 preferences. So in the past year, we have had more volunteers for prototype than we have had spots to put them in, and we hope to continue that trend.

We also used some detailer guarantees to help us make retention numbers, as well as to afford opportunities for those Junior Officers who go to shore duty and do those tough jobs for us in PCUs and NPTUs. Some of those involve platform selection as a Department Head or even a home port guarantee for their Department Head assignments.

The last thing I'd say is that during the PNEO examination day at Naval Reactors, we actually provide quite a bit of detailing opportunities to those JOs, and we talk to them up there. We have started recently, as a result of one of our JO symposiums, which I'll talk about here in a little bit, to offer updates to Junior Officers on what's going on around the fleet. This affords an opportunity for a Junior Officer that has been serving on a ballistic missile submarine, to get a brief at the Secret or Top Secret level of what our submarines are doing in the Western Pacific AOR. As an example, next week we'll actually provide a brief to the Junior Officers at Naval Reactors on how we do undersea rescue, an area that was near and dear to my heart at Squadron 11.

I talked a little bit about Junior Officer retention already. I'll just highlight some on this slide. You'll see in the upper left-hand corner, as



I talked to earlier, we did miss retention goals in year groups 08 and 09, but that was only by one or two officers.

Year group 10 is the year group that we're focusing on right now. As you can see in the upper right-hand corner, we have 115 officers retained as Department Heads, and our goal is 116. We still have 33 that are undecided, so I think we have a decent shot to get that last officer to make our goal for year group 10. The remaining year groups continue on track, but it is something we watch closely, especially with the economy continuing to be red hot.

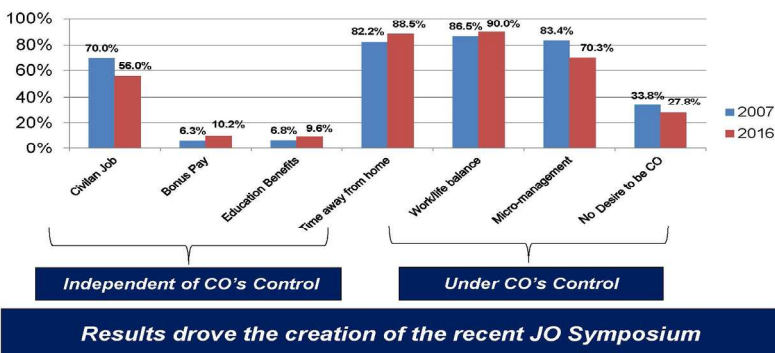
I talked a second ago about the JO symposium. It was one of the initiatives that my predecessor Admiral Houston stood up as a result of a look at the retention rates in year groups 08 and 09. But before we went in to do a JO symposium, we analyzed the results of a submarine JO survey. I'll throw the quick JO survey results up on the board, and you can compare JO survey results from 2007, which was the last survey we did, to 2016.

We had a much better return on our survey inputs from Junior Officers in 2016 than we did in 2007. But I would say that a lot of the same dissatisfiers, if you want to put it that way, are similar from 2007 to 2016 as far as what's influencing Junior Officer resignations from sea. So about half the reasons, as you can see on the left, are really the nature of



## **Junior Officer Retention Survey** **Why JOs resign – 2007 and 2016**

### Reasons Influencing Junior Officer Resignations



being a worldwide deployed operational force. The others are things we can and should go after. It is one of the areas that I work very closely with N97, Admiral Caudle and Admiral Tofalo on.

We did take what we learned from the JO survey and we put it into the topics that we addressed with our Junior Officers at our first ever JO symposium that we held in 2016 in San Diego. We had about 25 Junior Officers. I won't say we hand-picked those Junior Officers, but we looked for Junior Officers that were well respected in their home ports, because we brought Junior Officers in from all over, even those in the shipyard and those in the nuclear power training units as well. We had them come to San Diego for two days and we brought up many of the dissatisfiers that came out of the JO survey and we asked for additional ones from them on things we could do better.

I listed many of the lines of effort on the slide that we tried to take on. As you can see, we went all in on this JO symposium. I had a chance to sit in the back and listen to what the JOs had to say, and I can tell you that we, as you saw earlier on this panel, had an amazingly talented group of Junior Officers. I'm glad I don't have to compete with them nowadays.

But they did ask us to make some changes, especially in the detailing world, and we took that on. We became a little more transparent in the



## **2016 Junior Officer Symposium Results & Way Forward**

- **San Diego, CA 7-8 December 2016**
- **25 Junior Officers**
  - All homeports & major shore duty areas
  - Volunteers, committed to improving Sub Force, no requirement for DH commitment (to solicit diverse opinions)
- **Senior Submarine Force Leadership**
  - Reps from CSF, CSP, SLC, PERS-42, N-133, NRLL
- **JO Survey & Pre-Symposium collaboration identified Lines of Effort:**
  - Detailing Process
  - Prototype & PCU Assignments
  - Recognition for Top Performers
  - Leadership and Mentoring
  - Work-Life Balance
- **Mixed format:**
  - Large and small groups to generate then refine proposals
  - Senior Leadership vetted policy proposals
- **Delivered:**
  - Brief for Force-wide distribution and area briefs
  - ALSUBFOR "Submarine JO Symposium" SITREPs – policy changes and recommendations
  - Framework for sustained "Junior Officer Council"

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way we do detailing for Junior Officers, and I would say that it is really a benefit to us, as you can see by the numbers of Junior Officers we have playing slates right now. For the last two slates I actually had more Junior Officers that wanted to play to go to shore duty than we had jobs for. I had more volunteers for prototype than I had prototype jobs for.

I'll add that we're already knee deep in the planning for our next Junior Officer symposium, which we'll hold in the spring of 2018. I already have the head of the next year's JO Symposium, Lieutenant Ariana Pybus, working with me. She is currently underway on USS *Georgia* on her shore duty. She's assigned as a LNO to the SEAL detachment in Norfolk, Virginia, and she has already reached out to a network of Junior Officers. We're going to start to grade our homework on how we did on the lines of effort from our last JO symposium and what can we do to get better in the future.

One of the areas that the JOs were very excited about was Sailor 2025. I won't talk too much about this, I'll just highlight a couple of the ones that I'm pretty excited about and I think we're going to get a significant return on investment from in the future. The first is the SECNAV tours with industry.

I've had a chance to talk personally with several of the officers that have already gone through the SECNAV tours with industry, one at Oak Ridge and one at GE Digital. We're now looking, as those officers start the SECNAV tour with industry pipeline, to bring them to our type commander offices in either N4, N8 or N6 depending on the industry they're going to go work with, and then stop them by the Pentagon to talk with N97 as to what they can do to help the Navy in their tour. Then we're going to start looking at putting them in jobs that will benefit the Navy with the experience they gained in the commercial sector. For instance, we just recently placed an officer who finished his SECNAV tour with industry, GE Digital, in the N80 office in the Pentagon.

Naval post-graduate school is one that I continue to beat the drum on. I know that there's some exhibits upstairs of many in the post-graduate school who had a great deal to get a graduate education opportunity in Monterrey. We're already well above the number of naval post-graduate school officers that are going this year, even compared to last year.

The last one I'd mention is the Fleet Scholar Program. This is prob-



## Career Opportunities – Sailor 2025

- Fleet Scholar Education Program (FSEP)
- Oimsted Scholarship
- Politico-Military Masters (Pol-Mil)
- Legislative Fellowship Program
- Council on Foreign Relations Fellowship
- Federal Executive Fellowship
- White House Fellows Program
- Leadership Education and Development (LEAD)
- Graduate Education plus Teaching (GET)
- All Service War Colleges (includes multiple foreign WC)
- MIT/Woods Hole Institute (WHOI)
- Secretary of the Navy's Tours with Industry (SNTWI) Program
- Presidential/Vice President/SECNAV Aide/personal staff
- Overseas Shore Duty – Naples/Yokosuka/Bahrain
- NROTC - Opportunities for Civilian graduate education
- Third year option at NPTU
- Homeport/Platform guarantees
- Career Intermission Program
- Naval Attaché Program
- Naval Post Graduate School (NPS)

**Rewarding the most talented cadre of Naval Officers!  
Sailor 2025 – Recruit, Retain, Reward the Best!**

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ably the most prized of the Sailor 2025 Initiatives within the submarine community right now. This gives Junior Officers an opportunity to choose a school. The Navy will pay for their graduate education, especially if it's in a discipline that we can use.

Some of those are varied. MBAs really help us, for those that want to go in the acquisition community. So this last year we selected four of probably our best and brightest officers to go to places like the Kennedy School and Wharton.

I'll just highlight that we have over 130 graduate education opportunities in residence right now for our post-Junior Officers on shore duty. Forty percent of the jobs that Junior Officers fill on shore duty allow them an opportunity to get a dedicated in-resident graduate school degree, which is the highest of any unrestricted line community right now.

I'm going to phase in here and talk briefly about submarine gender integration. I know we've had many talks on that, but I would say that it has gone very well. The enlisted integration on *Michigan* is complete. We just had an opportunity to out-brief our flag officer leadership on how the integration has gone. We're taking those lessons learned, as we're already now starting to integrate on *Florida*.

We have 25 enlisted women on *Florida* already. *Michigan* is com-



plete. Overall, we have 82 enlisted women in the submarine service right now. The rest of the stuff up there has already been highlighted by Admiral Tofalo before, so I'll skip over and shift gears to nuclear Limited Duty Officers.



## Submarine Gender Integration

### Officer Integration

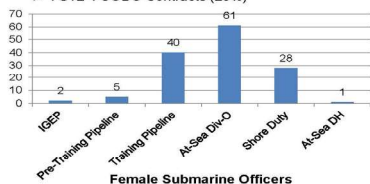
#### Status update

- 18 SSBN/SSGN/SSN crews integrated
- VIRGINIA-class integration underway
  - Integrated: VIRGINIA, MINNESOTA, TEXAS, MISSISSIPPI, JOHN WARNER (FY18)
- 1<sup>ST</sup> female DH reported to the Fleet (USS TEXAS)

#### Strong interest among women at accession sources

#### Favorable retention performance

- 7 resignations from sea duty (similar to male rates)
- Retention higher than expected (12.8% planned)
  - YG10 4 COBO Contracts (21%)
  - YG11 4 COBO Contracts (25%)
  - YG12 4 COBO Contracts (26%)



### Enlisted Integration

#### Enlisted integration of submarines is underway with USS FLORIDA in 2017 & USS OHIO in 2018

- Integration of MICHIGAN is complete
- FLORIDA non-nuclear conversions are reporting now, nuclear selections complete
- Non-nuclear Sailors have been selected for OHIO
- Integration is progressing smoothly and deliberately onboard SSGNs with lessons learned being shared between TYCOMs

#### Nuclear Enlisted Integration Plan

- No conversions from the surface nuclear enlisted community planned
- Nuclear-trained enlisted women are being selected from the training pipeline
  - 2 JSIs per integrated submarine crew
  - 4 non-JSIs per integrated submarine crew
- Women in Nuclear Power Coordinator stationed at SLF Norfolk to develop leaders as mentors and provide mentorship to junior female nuclear-trained Sailors across Fleet

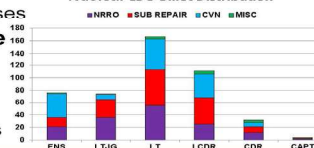
**Integration on track, but steady non-nuclear enlisted applicants are needed**



## Nuclear LDO Community Update

- **Several years of low accessions resulted in manning shortfalls**
- **Recent changes to the Nuclear LDO Application increased participation by ~100%**
  - Removed some of the administrative burden
  - Removed the requirement for conditional releases
- **Nuclear LDOs selected by Nuclear-trained major Commanders at a separate board**
- **Nuclear LDO accessions increased to 42/year (previously 36/year)**
  - Selections predominately Junior E7s and E6 EPs
  - Larger number to account for new billets and losses
- **Working on a Nuclear LDO Bonus Increase**
  - Increasing the bonus from \$10K/year to \$15K/year
- **NNPP still needs top talent to be LDOs**
  - Most LDOs directly support the Submarine Force
  - Continue to execute regulatory oversight of shipyards

Nuclear LDO Billet Distribution



**Most LDO/CWO billets directly support the Submarine Force**

The Limited Duty Officer community as a whole is pretty near and dear to my heart. I had an opportunity to serve with some real top shelf

LDOs during my time on *Jimmy Carter*, Squadron 11, and through my times on submarines in interfacing with the maintenance activities. But I will tell you that this is the community that I'm worried the most about in my job at PERS-42 right now. Several years of low accessions, which resulted in some manning shortfalls, especially in the mid-lieutenant to early lieutenant commander grades in the LDO community.

I'm spending significant time in this area right now, and we're looking at ways that we can minimize gaps. We are having to prioritize sea duty manning over shore duty manning in this community. These LDOs are sourced from both the surface and submarine communities. We take about 60 percent of our E6, E7 and very small numbers of E8s from the submarine service to be nuclear LDOs, and the surface community contributes about 40 percent of the same rates.

But combined with some low accessions, the dis-establishment of the Chief Warrant Officer (CWO) community about four years ago – which I came up with that idea so I'm kicking my own butt right now – and the continued growth in the Virginia-class has really caused a little bit of a divot in our LDO manning. So we have gotten after this problem by changing the application process for LDOs that come out of the nuclear field. It's much simpler. It's down from about 14 sections to two now.

We have a new board. We will convene our first one in about a week and a half in Memphis, which we will use submarine, surface nuclear and aviation nuclear, carrier CO officers, to sit that board and choose our next generation of nuclear LDOs. I'm happy to say that already we have over a 100 percent increase in the number of applications for the nuclear LDO community this year. We're up at about 200, so we have a very good cross section that can keep this community healthy in the future as we go forward.

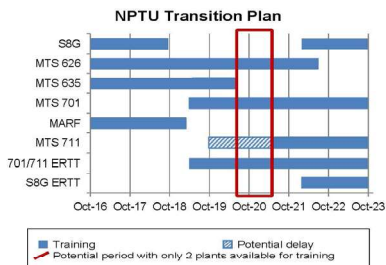
Talking about the training pipeline, I'm going to spend the last part of my brief talking a little bit about the enlisted side, and I'll wrap up. The nuclear power training units are going to go through a transition in mid-'19 to mid-'20 where we forecast we'll be down to just two training platforms. As a result, we've already started to get ahead of that by dialing down/up enlisted accessions.

In fiscal year '18 we reduced accessions by 440. In fiscal year

'17, we plussed it up about 220. Then in fiscal year '19, although not



## Training Pipeline Transition Plan



### High NPTU throughput in the near term will be followed by limited throughput in FY19-23

- Periods with only 2 plants available for training will limit nuclear enlisted throughput at the training pipeline
- Due to shipyard limitations, MTS conversions have been delayed

### Mitigation/Actions

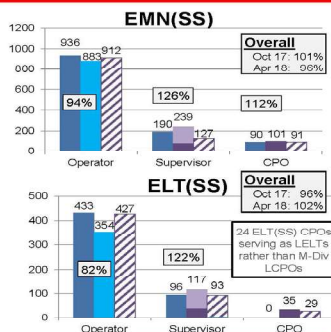
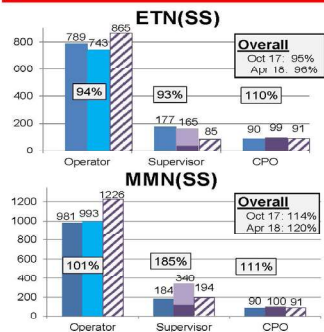
- Adjusted nuclear enlisted accessions by 220 in FY17 and FY19 to mitigate throughput-limited accessions in future.
- Reduced nuclear enlisted accessions by 440 in FY18 to mitigate increased hold pools during reduced NPTU capacity.
- Qualification Waivers and Cross Plant Qualifications
- Engine Room Team Trainers reduce reliance on critical plants for training

**NPTU Transition is critical to future health of nuclear manning** 16

approved, we forecast we'll bring back that divot by adding another 220 accessions. What that really does is it prevents accumulating a large hold pool of students during the period of time from mid-'19 to mid-'20 when we're down two training platforms. Ultimately, at the completion of this transition, we'll have three reactors and three engine room team trainers that Admiral Caldwell alluded to earlier in his brief.



## Nuclear At-Sea Manning Submarine



Data as of 1 Oct 2017, inventory does not include manning on VA-class beyond SSN-792, CITY OF CORPUS CHRISTI, HOUSTON, DALLAS, LA JOLLA or SAN FRANCISCO  
 Projected inventories are from Spring 2017 Distributable Inventory Projection  
 CPO inventory included frocked E-8s (does not include E-8 or E-9)

**First sea tour manning (Zone A) is healthy, mid-career (10-15 year) nuclear enlisted Sailors remain undermanned – FIT 92.5% – FILL 106.2%** 17



The last couple of slides here on nuclear at-sea manning, as I mentioned earlier we're very healthy overall in the nuclear enlisted at-sea manning. Our fill is over 100 percent and our fit, even in our most constrained ratings, is at about 92 to 93 percent. What this graph is really meant to show you is – it can kind of be an eye chart and very complicated – it breaks it down to our four enlisted ratings. It shows you that the dark blue is the billets that were authorized, and the light blue is how many we actually have onboard in the Navy that are qualified as an operator. In the hashed area is what we project that inventory to be in the next six months.

That's for the operators. For supervisors, those are the Sailors that are generally greater than nine years of service in the Navy, although an operator can get a supervisory NEC at sea after just four years onboard the ship. You can see that overall, we tend to be pretty healthy across the board in all those areas.



## Nuclear Enlisted Sea-Shore Flow (SSF)

Years of Service	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Previous Nuclear Sea Shore Flow	Training 22 Months			Sea-1 54 Months				Shore-1 36 Months		Sea-2 48 Months (if E7, 60 if E6)				Shore-2 36 Months			Sea-3 36 Months			Shore-3 36 Months			
New Nuclear Sea Shore Flow	Training 24 Months			Sea-1 48+1 Months				Shore-1 36+1 (+4 if NPTU) Months		Sea-2 40+1 Months				Shore-2 36+1 (+4 if NPTU) Months			Sea-3 40+1 Months			Shore-3 36+1 (+4 if NPTU) Months			
										10-Year Gate							17-Year Gate						

**Modified in Dec 2015 in order to:**

- Create an executable SSF model. Old model "unexecutable" and could not be followed
- Improve Quality of Life – Initiative from fleet feedback
- Improve 2<sup>nd</sup> Sea Tour manning with E-6 sea-returnee Sailors
- Improve EDMC Manning – 3<sup>rd</sup> Sea Tour in a 20-year career via "Career Milestone Gates"
  - o 10-Year Gate effective in 2016
  - o 17-Year Gate not effective until 1 January 2018

**Roll-out of new SSF:**

- Sailors at sea with PRDs beyond June 2016 had their PRDs automatically adjusted to new SSF
- With required on board qualifications, Supervisory NEC is now granted to Sailors with greater than 4 years of active duty service (vice 6 years)
- PERS-403 writing all new orders to comply with the new SSF
- Waivers to Career Milestone Gates approved via the Instructor Screening Slate process between PERS-403 and N133

**We continue to closely monitor the transition across fleet and at local elements as SSF continues to phase into community**

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One of the areas that we were most concerned about in the nuclear enlisted community for all of our ratings is that second sea tour for our Sailors. One of the actions that we took about two years ago was to re-vamp what's called sea-shore flow. This is, for all intents and purposes, the nuclear enlisted career path.

What we did was we shortened the first sea tour from 54 to 48



months, and the second sea tour from 48 to 40 months. What that really did was allow for an increase in quality of life for those first tour Sailors to get back to shore duty, just like we do with our JOs, give them the opportunity to look at re-enlisting. And as a secondary benefit, it also allowed us to have those Sailors that were qualified as an EDMC actually have time in their career path to go back for a third sea tour and serve as an EDMC.

The prior career path actually was enabling those enlisted Sailors that had qualified and been promoted to E8 and were ready to go EDMC to retire before serving as an EDMC. The flow point was at the 18-and-a-half-year point and they didn't have the full time to make it back to sea before their 20-year retirement if they wanted to do that. So I'm pulling this sea tour to the left. We've actually gotten a third sea tour out of many more of our Sailors and our EDMC inventory increased by about 40 available EDMCs just upon the delineation of this process right there. And then if you look even further out, we even have the ability now to get a second EDMC tour out of a select number of our senior enlisted Sailors. Right now, we have about 90 EDMC billets in the fleet and about 10 percent of them are second tour, preferentially to the pre-commissioning units and the SSGNs.



## Nuclear Enlisted Retention Submarine SRB and ESRP Bonuses

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
Career Path	TRAINING			OPERATOR				SHORE				LPO or LCPO				SHORE				LCPO or EDMC				SHORE	
Reenlistment Zone				ZONE A				ZONE B				ZONE 1				ZONE 2				ZONE 3					

### NEW Submarine Nuclear Enlisted Bonuses:

	Zone A Multiple	48 months add'l service for an E-4	Zone B Multiple	48 months add'l service for an E-6	Zone 1 Multiple	48 months add'l service for an E-6
<b>ETN(SS)</b>	11.0	\$97,000	9.0	\$100,000	9.5	\$100,000
<b>EMN(SS)</b>	5.5	\$48,000	8.0	\$99,000	6.0	\$84,000
<b>MMN(SS)</b>	8.0	\$70,000	9.0	\$100,000	7.5	\$100,000
<b>ELT(SS)</b>	10.0	\$88,000	8.0	\$99,000	8.0	\$100,000
			Zone 3 Multiple	24 months add'l service for an E-8	36 months add'l service for an E-8	48 months add'l service for an E-8
	Zone 2 Multiple	24 months add'l service for an E-7	AOS <24 mo	0.5	\$5,000	
			AOS 25-36 mo	1.5		\$22,000
<b>All Ratings</b>	3.5	\$30,000	AOS >36 mo	2.5		\$50,000

**Lifetime Bonus**  
\$312k to \$377k

**Largest lifetime bonus of any enlisted Sailor**

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So I'll end on what I think is a good note. When it comes to the enlisted community, as you can see on the bottom there, the typical nuclear enlisted Sailor can get a lifetime bonus of about \$312,000 to \$377,000. We're the only community – and when Force Davenport was my CMC at Squadron 11 he was always very jealous of this – but it is the only community that continues to provide bonuses for Sailors well past their 20 years of service.

In fact, I have one caveat to add on there. We even provide our E5 nuclear Sailors that go and serve at our prototypes an additional pay per month that's equal to the pay that the Master Chief Petty Officer of the Navy's (MCPON) gets. So our Sailors are pretty well compensated in the Navy. They do a very tough job, but we look at this very closely every six months to make sure we can use this as a lever to influence retention in the key rates that we need it.

So with that, I'll open the floor to any questions.



**NAVAL SUBMARINE LEAGUE  
35TH ANNUAL SYMPOSIUM**

**UNITED STATES SUBMARINE FORCE: GETTING FASTER**

**PROGRAM MANAGERS PANEL  
MS. MEGANNE ATKINS, PMS-435  
CAPTAIN B. CORY JACKSON, PMS-425  
CAPTAIN SCOTT PAPPANO, PMS-392  
CAPTAIN MICHAEL STEVENS, PMS-450**

VADM DONNELLY: I'd like to call our panelists up to take their seats, please. I'd like you to just look at this group here. This is an incredibly talented group. I was talking with retired Vice Admiral Paul Sullivan in the back of the room earlier, and he said the submarine force values their acquisition professionals' community more than any other group in the Navy.

From my experience – and I'll go through the bios briefly of these people before they speak – but from my experience we hand pick about three a year to go into this community. The decision is made jointly by Naval Reactors because they sign off on all personnel decisions, and both force commanders. We look at each commanding officer and we say, alright, these guys are going to be really important to the future of the submarine force. Let's pick the right ones, and we pick three a year.

Typically, one of those three will be promoted to flag officer several years later after they've done tours as a program manager and a major program manager. So it's a very careful and deliberate selection. The other communities don't get it the same way we do.

The plan, which I have not discussed with anybody here, is that I'll make a brief introduction and then I'm going to ask you to speak for three to five minutes about your program. Then we're going to open it to you all for questions. The program managers here represent a great cross section of all the programs that matter to the submarine force. So for the audience, this is your opportunity to really throw some fast balls at them and see how they do.

In no particular order, Captain Mike Stevens on my left is the pro-

gram manager for the Virginia-class submarine, PMS450. He served in command while I was the commander of submarine forces and I got to know him quite well. He was the CO of USS *New Hampshire*, SSN778. That was the very first Virginia-class submarine to make an overseas deployment. It set a record, which still stands, for the shortest period from the time of delivery of the ship to deployment overseas. His ship won the Battle Efficiency E the very first year he was eligible to win that award, quite an accomplishment of command.

Prior to command he had a whole series of operational assignments USS *Texas*, *Kamehameha*, *Alaska* and *San Francisco*. He also served on Capitol Hill and was in the N87 Submarine Warfare Directorate at OPNAV and was also on the Naval Propulsion Examining Board. That's Mike Stevens.

We also have Cory Jackson. Cory is a Naval Academy 1990 graduate. He had a number of similar career pattern assignments on the *Henry M. Jackson* and *Pennsylvania*.

His ship won the Battle E while he was on *Pennsylvania*. Then he went to be XO on *Corpus Christi* in Guam, where the ship won two Battle E's. And then he went on to be the commanding officer of the USS *Alaska*, where that ship won the Battle E and the Omaha trophy as the best strategic ballistic missile submarine in the fleet.

He then transitioned to acquisition professional. You can kind of see the pattern here. Really top performing COs that are picked to go run our major programs. He is now the PMS425 program manager for combat and weapons control systems.

Captain John Newton, Naval Academy class of 1991, commander of USS *Maryland*. He also served on *Simon Bolivar* and *Topeka* and USS *Memphis* and USS *San Juan* and USS *Scranton*. You just kept doing it until you got it right. He is the program manager of PMS399, the SOF undersea mobility program, so dry deck shelters, advanced SEAL delivery systems all fall into his purview.

We have Meganne Atkins. She is PMS435 program manager for submarine electromagnetic systems. She has had a range of program manager assignments and was also stationed at the Naval Undersea Weapons Center at Newport, Rhode Island. So we're looking forward to hearing from her on that.

She was the small business innovation research lead for Virginia-class submarines and there are probably several of your small business customers in this audience. This is your opportunity. Also, deputy program manager for non-propulsion electronic systems (NPES) for Virginia-class submarines and was the technical director for the advanced development in IWS-5. She fleted up to her current position from the deputy program manager position.

Then finally, it was going to be Admiral Goggins, but Admiral Goggins got pulled away so he sent Scott Pappano. Scott is PMS392, program manager for in-service strategic and attack submarines, so he is the program manager after delivery of the submarine that looks over both our SSBNs and our fast attacks. Again, a Naval Academy graduate of 1989 and then he served on a variety of operational assignments. He somehow found time to go earn a Master's degree at MIT. We're pleased to have you. He is also one of our award winners that you'll see at the awards luncheon tomorrow, where he won the J. Guy Reynolds award for excellence in submarine acquisition.

Why don't I start with John and we'll work this way? If you could give me three to five minutes, just say a few words about your program, and then we'll turn it loose for questions.

CAPT JOHN NEWTON JR.: Thanks, sir. What I would first say is, Admiral Donnelly, thanks a lot for the chance to visit with you today. I have memories of Admiral Donnelly – we served together when I was a young JO in '87. Several years later when I was in command and he was SUBLANT, he rode my ship when I was on *Maryland*, and that's one of my cherished memories, getting a chance to salute you as you left my ship after our time together. It's great to be back and visit with you all today.

I am your SOF (Special Operation Forces) undersea mobility program manager and I support all six dry deck shelters. We're dual-sponsored through both SOCOM and OPNAV-N97, and we maintain the Navy's inventory. We maintain the six shelters and the Navy's SOCOM undersea mobility inventory. At this time, the four SSGNs are our primary users. We also have six Virginia-class submarines in the DDS Host Submarine inventory (4 primary and 2 backup).

It's a great office. I've been blessed in this job. We get great support

from SOCOM and from OPNAV-N97. Clockwise from the top left, I'll talk a little bit about all these pictures.

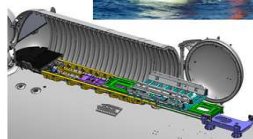
At the top left you'll see an SSGN going to sea with dual shelters installed. You'll see SEAL and Navy divers operating in a flooded dry



## SOF Undersea Mobility Program (PMS 399)



- Mission – Coordinate all aspects of support, sustainment, modernization for Dry Deck Shelters, SOF Designated Submarine Systems, and Future SOF undersea mobility systems.
- DDS Inventory: 6 units are fielded with service life ranging from 2042 through 2051
- Supports clandestine delivery of SOF and provided unique capability and options to the Warfighter
- Growing support to Unmanned Systems in man portable and large assets such as LDUUV
- Dry Deck Shelter Modernization will dramatically increase capability



deck shelter. Think of it like an underwater garage. We can egress divers in and out, in a mass swimmer lock out mode with all their SOF peculiar gear and we can host SEAL Delivery Vehicles (SDV). We can do some forms of Unmanned Undersea Vehicles (UUV), such as the REMUS vehicles and some man portable units. As we get deeper into the POM, we will also be supporting larger UUVs and other submersibles for both SOCOM and Navy customers.

Go to the right and we'll see the USS *New Hampshire*, heading to sea with a dry deck shelter. We're working with SOCOM and the Navy to figure out the right way to transition from the SSGN to the Virginia-class host over the next few years. It's an interesting part of the problem and we look forward to growing that capacity.

You can see an SDV heading out to sea in the middle tier. In the middle tier on the right you'll see a very exciting program we're working now. It's a cartoon, but there are actually parts of that that are prototyped now.

There's our DDS modernization program. We're working with Oceaneering and Electric Boat and a big team of government facilities. We've had support since 2015, our first contract award. We're getting past our design review now, and this is going to give us some pretty exciting stuff.

We're going to make it 50 inches longer and providing the capability to hold about 30 percent more volume, both longitudinally and also through reconfiguring the interior arrangement. It will give us almost 300 percent more weight capacity when complete. We are providing greatly increased capability and options for the force and I'm very fortunate to help this program mature.

Finally, we support the Navy and PMS-450, the attack submarine office, as they work with the TSEP program that you saw some elements of before as they work to reconstitute SOF or account for SOF, and we're happy to support that effort. The last picture you see on the bottom is our large UUV, Mobile Anti-Submarine Training Target (MASTT). We are not the only leader in Navy unmanned undersea vehicles, but we certainly support this effort and we're proud to work with the MASTT and other UUV programs.

That's an effort I work in partnership with NUWC in Washington. They manage that force on Coronado Island, and it has done great work. It models a diesel submarine.

I'm very proud to report our first ever interaction of MASTT with a submarine in shared water space this year. I look forward to further developing this capability forward as we work through the POM.

CAPT MICHAEL STEVENS: It's good to be here with all of you again. It's great to see so many familiar faces. The Virginia-class program is really excelling and it's a credit to the shipbuilders. When you think about where we were in the middle of the '90s, we almost stopped building submarines for a little bit. It was sad times, right?

Today, we're delivering two a year and delivering two very fine ships a year. I get to ride the alpha trials with Admiral Caldwell, of course, leading it. It's a great pleasure to ride those ships.

Just the other day I was walking the dry dock for the *Washington* post-shakedown availability. I can attest to you that that ship is in the best material condition of any Virginia-class submarine we've ever built.



I probably would stretch that to any submarine ever, but that might be too far.

It's in excellent shape, a really phenomenal submarine. The shipbuilders really should be congratulated for getting up to that kind of pace that we're on today. The ships, too, I can attest firsthand are phenomenal in terms of their acoustic superiority.

We're doing some big things going forward, including the Virginia Payload Module which Admiral Selby just talked about. The design of that is going very well and we think we're in good position to insert that increased capability into the next block. That will really take these ships to the next level and replace the SSGNs as they go away, recapitalizing that strike capability that we're going to lose when the SSGNs retire.

And then we're tied closely with N97's Tactical Submarine Evaluation Program. I think that's a great program that we're looking forward to, after we get started with Block 5, beginning to look how we can insert in a more incremental fashion even greater capability and technology. So we have some really interesting and exciting things we're working on, that I can't really enumerate here in this particular forum. But stay tuned because I think that there's some really cool things coming about to make these submarines even better if that's even possible. I don't know that it is.

I would like to also say that the last two ships, the *John Warner* and the *Illinois*, so the SSN 785 and 786, we completed their post-shakedown availabilities. We contracted with the shipbuilders to do it in six months. They both completed ahead of schedule and we're on a target to get down to three months PSA.

It's something Admiral Tofalo really pressed upon me. We were at the christening of the *Washington*. It's supposed to be a happy time, just drinking orange juice or whatever, and I got cornered about how we're not getting those boats out fast enough.

So we put our foot on the gas pedal and we pressed on the post-shakedown availabilities to get those shortened so that we can get these very fine submarines out to the fleet faster. It's such an advantage for the crew, to come through all those trials, and it has done so much to get up to speed. They go through the acoustic trials, the weapons systems acceptance trials, and they're really at a fine point in terms of proficiency.

And then to just go into a short post-shakedown availability and march right into their fleet readiness training program is really advantageous to the fleet. It keeps the crew kind of in one piece, so they don't break up after a long post-shakedown availability. And again, that has been made possible by the exceptional work that our two shipbuilders, and all the vendors who support them, do. So we do need to step back and pause and congratulate ourselves. I see some fine work and it's really exciting to be a part of it.

Really quickly I want to address a question. Virginia-class does not have a turning radius problem. It is an excellent ship in terms of turning radius. We have designed the VPM to account for its length. Admiral Selby's folks have looked at that in depth and it is incorporated in the design and it is within our performance parameters. So it's a fine addition and I think you'll be very pleased when we actually get that out to the fleet.

With that, that's probably more than five minutes, I don't know.

CAPT B. CORY JACKSON: Thanks for the opportunity to be here. The main product that my program office delivers is the AN/BYG-1 Combat Control System, which has two halves, as reflected in the name of the program office. The two sides are the combat control side and the weapons control side. The combat control or the fire control, traditionally just like you would remember probably from some of your days on the ship, is taking data from sonar and turning it into tracks that we can use to put weapons on target. That's the other half of the system, the weapons control system.

With the weapons control system we have started a transition. We actually have our first contract called the Payload Control System, and we're expanding the definition of weapons to include all payloads that can be handled by the submarine. We've already done some of that.

We've gone beyond traditional torpedoes. We have integrated the Tomahawk strike software. We don't use dedicated servers that once were needed to do strike onboard. We basically take the software, we virtualize it, and it's integrated directly into the AN/BYG-1 system.

We've done the same thing with the navigation system developed by IWS-6, the VMS system. Those programs are virtualized and run on our servers and our displays and operated in the control room seamlessly.

It's all part of the Submarine Warfare Federated Tactical System, the system-of-systems that includes both my program, Meganne's program, and CAPT Rich Arnold, who is not here, with PMS-401 and ARCI for sonar.

The other exciting thing that comes along with SWFTS is -- one of the key pieces at the center of all this is our Enclave Guard System. We handle data at many different classification levels and we don't have the room onboard to do multiple networks that are redundant, because of the space limitations onboard a submarine. So we handle that information assurance problem through the use of an Enclave Guard, and that's part of my system as well.

Lastly, we've started -- when I was mentioning payloads -- we're standing by with the payload control system to be the receiver of payloads that are mature and ready for integration. One of the first things that we've done is we've taken a joint tactical demonstration using a Blackwing vehicle, which is a three-inch form factor that is sent out of the signal ejector and launches a UAV that will send back video to the submarine that we can use for over the horizon targeting, or third party targeting. We're integrating that into the system and our office is leading the effort in that area as well.

MS. MEGANNE ATKINS: Thank you again for the opportunity to be here. My name is Meganne Atkins and I'm the program manager for submarine electronic systems. Within the portfolio we have radar imaging and our EW systems. I say it's a very exciting time to be in the acquisition command because we're going through three new acquisitions on all three of our programs. We have both inboard and our outboard sensor acquisitions going on right now, which is exciting, and I think is an opportunity for industry really to get involved and help us deliver capability to the fleet as fast as we can.

Our first system is radar transitioning from our mil standard B-16/15 radars over to a COTS-based radar, which we'll deliver in Block 4 Virginia-class, a new construction hull, and 792. It's a non-hull penetrating COTS radar. Additionally, the way we used to handle our B-16 radars when they weren't operating exactly how we wanted them to is we put a clip-on COTS radar on the front, and that helped solve some of those problems. So we have integrated that secondary radar as part of the overall radar system, which is something the fleet has shown a lot of positive

excitement about, and we're really looking forward to that as part of our new system. Once we move forward we're looking at opportunities to back-fit that system onto other classes to resolve some of the older radar systems we have out in the fleet.

For our imaging system, we are in the middle of first article testing on the low-profile photonics mast, that's our first production low profile mast that we'll deliver to the fleet sometime next year. We'll be delivering those at about one per month once they start delivering, so that's another big change for our program.

Further inboard, we're going to be continuing down the path, along with Captain Jackson and Captain Arnold, part of the SWFTS process, of our inboard imaging system. We just put out the contract for TI-18 and we just put out our sources sought for TI-20 and 22. So again, we're really looking for industry to get involved and start looking at what we can do and where we can go with the inboard imaging system.

For the EW system, we put out a sources-sought a couple of weeks ago looking for our industry partners to help us look what the way forward for EW is. EW is a place where it's ripe for innovation. It was sole sourced for 20 years and now we're looking for industry to get involved and start to look at new ways for us to move the ball forward in that area. It's definitely a place for innovation.

Those are our big programs. If I don't have the opportunity to say any more, I would just like to say that when I was back in Virginia new construction I went out there and I realized we never called Electric Boat or Huntington Ingalls, our contractor, our vendor, they were always our shipbuilding partner. That's how I view our contractors in industry.

They're our partners and we have to have a good partner. When we have a good relationship, we can do really great things. So anyone who is looking to get involved in the submarine community, anyone who is looking to get involved and look for new innovative places for industry to get involved, 435 is a great place to start to look to move those relationships forward.

CAPT SCOTT PAPPANO: First I'll say for those of you who came to pepper Admiral Dave Goggins about the Columbia-class, my apologies. Instead, you get the in-service submarine program manager. But the good news is, that is 80 percent of the acquisition lifecycle, so I can

talk about way more things than Admiral Goggins.

You've already heard from the submarine leadership about what the Navy and the nation's top priority is, that's our strategic submarine deterrent. Admiral Goggins and I are at other ends of that spectrum. He's building the next generation of SSBNs. My job for all submarines is to maintain and modernize those ships throughout their life cycle to deliver the boats to the fleet and capability to the fleet.

My number one priority, not surprisingly, is the Ohio-class SSBNs and getting those ships to 42 years, a ship that was designed with a 30-year service life. We at NAVSEA did a detailed engineering analysis in the '90s to take a look whether we could extend the lifecycle on that ship. We did an Electric Boat design and our own independent assessment, and in 1998 decided that we could extend that ship to a 42-year service life.

The challenge of not having designed it for that is, what challenges did we not perceive? We foresaw a lot of challenges, but there's always something else. We're trying to take as much of a lead angle as we can on that ship to make sure we can dovetail that into the Columbia-class delivery.

There are challenges. We have, through fleet feedback, continued engineering reviews of that ship class. There are many things used in the four SSGNs, which I call an accelerated life cycle, if you will, to operate in a harsher environment, more operating cycles on the equipment on those ships as part of the normal SSGN mission profile, feeding all that data back into the SSBN pipeline to determine what work we have to do going into the future to make sure we get those ships up to 42 years. There are many other priorities, but that's our top one, and I'll just end it there.

VADM DONNELLY: You can see the broad range of capabilities they are responsible for. I don't have a question, so I'm depending on the audience to come up. Sydney Freedberg looks like he has a question loaded. I'll let you go first.

MR. FREEDBERG: This is what I get the medium bucks for, is asking a lot of questions. A question really across the board. Several of you have mentioned off-boarding. There's a lot of interest and intellectual ferment about making the submarines serve the manned hub of a larger



range of unmanned things under the water which may or may not come off the sub or may operate from land bases in parallel.

What kind of experiments, pilot projects, are you all doing in your various ways to not just actually develop the unmanned vehicles, but to actually communicate with them, which is not easy under water? You don't just sort of pick up your short-wave radio and yell. How are you actually working on the concepts, on the technologies, that will enable that vision to become a real thing?

MS. ATKINS: For 435 we are going towards building longer arms for the submarine. What we're doing mostly is we're relying on ONR and some of our other partners that are doing those S&T type projects. I know Admiral Hahn has come up with his new way to do FNCs and make sure that they're partnered from the beginning with the program office, so they have a place to transition.

So in our program office we're really looking at how to look at those in ONR and in particular to look at those areas and help us to move them forward. I'd say IWS-5 is also a part of our advanced processing build. They are looking at areas like that for advanced development and then they bring them into our production offices.

CAPT JACKSON: Communicating with all these off-board vehicles, like you said, is quite a challenge. My personal experience is mainly with air vehicles, and so we're talking RF (radio frequency) spectrum to one of the masts on the submarine, so it's old technology not new technology. I think it gets much tougher when you start talking about the undersea vehicles. I think John may want to talk about the experiment he did and if there's any lessons learned that came back.

CAPT NEWTON: It's a great question. I will say we're working that problem very hard. Acoustically there are options for that and the force is experimenting with acoustic communications. We've done a lot of work with tethered vehicles. I had a chance to work with the LRS program years ago, and we've established a lot of credibility with that for years and years.

You can get a lot done with autonomous systems as well, as far as there's independent navigation systems on a lot of these UUVs and you can make a lot of things happen just by getting back to a general area and bringing it back to the submarine, if you expect where it's going to

be. Beyond that, I think we're just working to develop the technology. As an interfacer, I'm mainly concerned with how we're safe and how we work with UUVs safely around the submarine and house them on the submarine, and that piece.

I will say that we've gotten great support from places like ONR and from the warfare centers. We've been working with things like LDUUV programs and other programs coming in and out of the dry deck shelters, and even out of some of the SOF interface lockout trunks. So we're making good progress.

I think there is a long way to go, because it is very difficult. In many ways, since you don't have that real-time control for a UUV, it makes the problem much more difficult. And then when you magnify on the adverse environment of the ocean, varying sound propagation paths and different environmental, it makes it very difficult.

VADM DONNELLY: Vice Admiral Paul Sullivan from Penn State.

VADM PAUL SULLIVAN: This is for Mike Stevens. First, I'd like to publicly thank you for allowing an extra flag officer on Alpha trials on *New Hampshire*. For those of you who haven't ridden Alpha trials, you've got the four-star at Naval Reactors, you've got the two-star PEO, you've got the one-star group commander, all breathing down your neck. The last thing you need is another three-star on board, but he took me in and it was a really nice Alpha trial.

My question is, you're the PM for a class that's going to two per year, that's going for the Virginia Payload Module, and you've got shipbuilders in the room here with you, how will you compete for design, engineering and water front resources? Can you talk about the integrated plan a little bit?

CAPT STEVENS: Yes sir, thank you. We had a clean sweep. We had two one-stars, a two-star, a three-star and a four-star onboard the submarine, so it was a lot of fun. I didn't eat much.

It wasn't that bad. It was a lot of fun. The integrated enterprise plan is an effort that we put together with the shipbuilders to ensure that as we go forward with Columbia, and then two per year Virginia and adding the Virginia Payload Module, that we have a very deliberate way to approach it with very distinct lines of effort to ensure that prior to '21, even a little bit earlier, the construction yards can handle the capacity.

I think they'll admit freely that ramp-ups are difficult, particularly when it comes to critical skills. They will attest to you first-hand that it's the critical skills that are so tough. You can hire a lot of people but having people who can do what you need them to do correctly the first time in shipbuilding is not easy. So a part of our integrated plan is to start to address how we can train those people and get them onboard.

More to your question, the design part of it, that's the first LOE (Line of effort), making sure that we do in fact have enough people on the design end of it that are implementing the ship's designs, getting done with the disclosures, the arrangements and disclosures. To this point it's really – I don't think at this point, particularly on VPM, manpower is not the problem. The real kind of transitional part where you've got enough arrangements that push through, so that's always kind of a knot right there, I think. We're moving through that well.

And then there's the transition to the new integrated product development environment, which is transitional as well. That's a new environment in which to design in three-dimensional CAD for instance, and that's transitional. That's challenging, I think, and we'll push through that. I think there's a good plan that integrated to get through it.

Did that answer your question?

VADM SULLIVAN: Close enough.

CAPT STEVENS: Close enough, good.

VADM DONNELLY: Ken Perry has got a question.

RDML KEN PERRY: I want to first congratulate Captain Stevens and your program office for what is regarded as the most successful transition program – (off mic) – theme of the conference, get faster. I'm going to ask, what are the changes that might help government get faster, and what would you like to see from industry to help get faster?

CAPT STEVENS: I think that's a great question. I was just at a dinner with the CEO of Raytheon. He was talking about where technology is going in the future. He's got some great insight and his point was the last 10 years you thought things changed a lot. You're walking around with a super computer in your hand. You think that's a big deal.

He said, the next 10 years, we're just hitting the knee on the exponential curve in terms of how technology is going to change our lives. You have things like artificial intelligence, quantum computing, and



things that are really going to revolutionize even to the next level. How do we keep up with that?

One of the points is, we have these requirements and we want to keep the requirements steady and we need to keep them locked so that we can build efficiently and cost-effectively. If we keep changing requirements so fast that we can't approach it in a deliberate fashion, scope creep occurs, growth occurs, and you don't build anything because it gets too expensive. So you want to control requirements but yet you need to keep up with the changing technology.

I think we've done okay. I think it's the CNO who has the graph that shows that we're kind of on this linear slope and our competition is on the exponential slope, and we've got to get on that. How do we do that from the government design perspective? It's definitely challenging because it's a slow, deliberate process on purpose because we are allocating or obligating billions of your dollars, you as taxpayers, so we need to get it right.

I think the Virginia-class is a great example of that. We started designing that in the '90s. We're delivering those ships today and they're phenomenal. They're still the best thing by far and away out there.

So we do it right to some extent, how can we do it faster? One of the things clearly is this Tactical Submarine Evolution Program or plan that N97 is leading. I think there's a lot of very innovative and exciting things that we're going to try to do mid-block.

When I say mid-block, we contract by a block. I'm taking up all the time here, so I'll stop, but we contract by the block and we don't tend to do big things between the blocks. That locks you out for almost five years, but you want to control growth and cost too. We want to get a fixed price and we want to be able to budget accurately and control that aspect of it. So I think how we integrate the TSEP between blocks and how we use it to potentially – we have a vision for '27 to deliver the [SSN] 806 as the most phenomenal platform ever, and I'm not going to get into any more detail on that. So there's a big teaser for you, right? But I think that's a good way to do it faster. I think N97 is doing a really good job at taking the lead and driving that, and hopefully we'll see some outcome from it. A lot of it is budget driven, so how quickly we change the budget, that's another behemoth that's difficult to really change very

quickly.

VADM DONNELLY: Let me squeeze in a few quick hitters here for Captain Pappano. You mentioned the challenge of extending Ohio-class to 42 years of service. This may sound like heresy, and there is media in the room, but are you building in any margins just in case Admiral Goggins fails? Can you get to 43?

CAPT PAPPANO: We made some very good decisions on Ohio, okay, on what the limitations might be at 42 years. So there's two sides of the picture. The enterprise decision to modernize the electronics system with the SWFTS model was brilliant because that takes both an obsolescence and capability improvements that make that go away for the rest of the life of the ship.

So I worry much less about the NPES side of the house than I do the HM&E side of the house. The HM&E side of the house is really where we're spending our time right now to make sure that we have – that we can take a lead angle on performance based on SSBN performance, based on continuing engineering. But it's going to be that stop-gap at the end there that stops us, that ends the life of the ship.

Right now, 42 years is what we've analyzed to. There are some unknown unknowns. We know we're going to be out there, but we're confident we can get to that point. I'm not confident we can go beyond the 42 years right now. So my perspective is it's imperative that the Columbia-class deliver when she says she's going to deliver.

VADM DONNELLY: Thanks. Meganne, when you start to field the low-profile photonics mast, you said one per month. What's your fielding plan? Will you replace both photonics on each sub at the same time, or one at a time until you get through the whole fleet and then go back for the second one?

MS. ATKINS: We have a plan right now to field up at least one low profile mast per ship, starting out in the PAC and starting next year until 2019.

VADM DONNELLY: I don't know much about that program, but visually will it be much different from the mast we're using on the 688-class submarine? In other words, will it be a class identifier for that mast launched to a Virginia-class?

MS. ATKINS: That's not the point. We're not going to do that if

at all possible. The original photonics mast, I think we've learned our lesson hard on that one.

VADM DONNELLY: For Captain Newton, is your plan for the extension of the dry deck shelter, does that contract modify all six DDSs?

CAPT NEWTON: No, we worked with Oceaneering and our design that we have designed is going to be able to be applied to all six dry deck shelters. So early on we envisioned there might be a need for that, so we have a design that's robust enough to handle that. We've looked at all the drawings and we think it will be applicable to all of them.

The six shelters were built over a 10 year period from 1982 to 1991 by different vendors. Just as any ship is built, there's a lot of unique differences in how they mate up to the individual submarines, what the piping configuration looks like in them. But we've accounted for that in the design.

My contract for the construction is for the first prototype technology demonstrator. We're looking at building that next year. We're working with my sponsors to figure out the plan for the rest of the force. Very appropriately, they want to see how well the dry deck shelter modernize program does when it hits the water and how pleased the operators are with it and what the actual need is.

I think I made this point, it's more than just an extension, a dramatic increase in volume. It also allows the capability to bring divers from outside the ship inside the skin of the ship to remotely operate the control on the flood drain and open and index the payload out with our hydraulically operated arm. That's what Oceaneering has designed for me. That will give us the potential for an autonomous payload to actually get the complement of people down onboard the submarine, which is going to be tighter on space in almost any configuration for the Virginia Payload Module boats or the extant Virginia-class SSGN. So I'm very excited about the program.

MR. \_\_\_: Since the word safety has been brought up several times and the name *Greeneville* has been brought up, where do we stand on the 360 look photonics mast and the photonics mast reliability issues that we had several years ago?

MS. ATKINS: The instantaneous 360 look is part of what we would put out for TOTIM, which is the next generation mast for imaging.



That's a bit out into the future. I can't talk about the specifics here, but that is probably a few more years out for the instantaneous 360 look, which I think is the demand signal that we're looking for.

Certainly, the reliability and availability of our system has improved greatly, and we have improved that over the last several years. Safety is certainly one of the things that is a major tenet for us. We had a safety stand-down within PEO Subs and we've doubled back on that even within our own program office.

So imaging and radar, as you can imagine when you're doing surface evolutions, those are your main sensors. We have refocused that in our office and we're looking at requirements, and within the program office, to make sure we're meeting all those safety requirements and making sure they're our top priority.

CAPT JACKSON: One of the things we've done with Meganne's ISIS (Integrated Submarine Imaging System) is, as you turn the periscope, even a legacy optical periscope, it paints a 360 degree picture on the screen and maintains it there. So not only the officer of the deck, but other folks in the control room see it and you get more than one set of eyes on the target. So I think we've made a lot of improvements on the imaging side of the system to really improve the ability to detect contacts when we're at periscope depth.

VADM DONNELLY: For Captain Jackson, back in my day many years ago, when a fast attack submarine would come back from special operations we would have to destroy a large number of hard discs. Has your enclave classification system alleviated that need?

CAPT JACKSON: Yes sir, it has. Early on, as you said, you'd come back, and you'd have a few hard drives. That grew to 20 or 30 hard drives, and I think at the most extreme we got up into the hundreds of hard drives that all had to be destroyed because they were at the higher classification level.

So we've developed a system design where a few key components maintain kind of the keys to the kingdom and they have to be maintained at the highest level. But the rest of the system we can downgrade and reuse the hardware at a lower level all the way to its end of life. Now at the end of life, just in case our methods to keep those sanitized didn't work, we do destroy them all at the highest level. It's necessary to de-

stroy them at the highest level of data that might have been on those at any time. But throughout the life, we can keep them in place and not have to worry about them.

VADM DONNELLY: My last question for Captain Stevens, now that the Virginia-class program has settled into two per year build rate, do you have any concerns about the supplier base, either for government furnished equipment or contractor furnished equipment keeping up with that? And are you concerned about the potential for three a year submarine construction when Columbia comes onboard?

CAPT STEVENS: I think we're all very concerned with the industrial base from a standpoint of, this is a significant amount of demand that they're going to see increase their way. If you talk to Blair Decker or Rear Admiral Goggins, they'll tell you that we're down to about 3,000 suppliers, many of them sole source. During the Cold War, the peak, it was closer to 20,000.

Certainly, our supplier base has narrowed and it's more sole sourced than it has ever been. We have, I think, a higher demand from that same supply base. There are particular suppliers that we're focused on, and what we're doing as part of the Integrated Enterprise Plan is there's a specific line of effort that's focusing on the material, identifying who are the common vendors. I think we're on the right track.

We've got a lot of work to do. It's a huge problem to tackle, identifying the common vendors and where their risks are. Do they have capacity going forward? How old are their tools, their critical skills?

Do they have the ability to hire more people? What's the job market in their labor region? Understanding all of that as we impact them in the next five years with potentially two to three times the demand, can they keep up with it? If they can't, what do we need to do to help them get to where we need them to be to deliver quality products at the rate that we need?

Some of the things I'm encouraged by. The builders, both Newport News and Electric Boat, are looking across all three programs, not just submarines—this is about the carriers too. They're in there. They order a lot of stuff, believe it or not. So through carriers, Columbia and Virginia with VPM, you're talking a lot of demand on some of these companies.

I've been out personally to over two dozen of them, and many of

them, you're not looking at these major manufacturing sites that are the ones – you know, you'll drive by them. If you're driving down the road, you'll drive by them and never know they are there. And yet, if that place shuts down you'd stop building submarines. So we've got to protect them and we've got to ensure they can handle the capacity.

I think we've done a lot with Newport News and Electric Boat working together to ensure that procurement orders in particular go out in a synchronized fashion so that we don't potentially overload the supply chain. It's beneficial to us for one thing. We get the real benefit of economic order quantity when procurements go out simultaneously. But it's also beneficial because then the particular company has the necessary information and it can determine that maybe it's a bigger contract so they can use it to go to the bank as collateral and use it to upgrade their machines. Or, they just have a better demand signal that they can plan out into the future years, which is so important for many of these companies.

Their planning horizon isn't the FYDP. In fact, if you say FYDP to most of these companies, they say, WHATUP? How do you spell that? So Future Years Defense Plan, they don't know it, they don't see it. Their planning horizon is a year, or two years, sometimes.

So to get them to understand what our real demand is going to be over time is the big part of the Integrated Enterprise Plan, if Admiral Goggins were here, he would talk the same thing. It's one of our key concerns. We just briefed Navy leadership yesterday and that was pretty much what the conversation devolved into for a good bit of the two hour discussion. So we're all very concerned, I think. We're doing many things. I would say everyone would agree it's not enough yet.

VADM DONNELLY: Very good. Please give a hand to this group.

**NAVAL SUBMARINE LEAGUE  
35TH ANNUAL SYMPOSIUM**

**UNITED STATES SUBMARINE FORCE: GETTING FASTER**

**JUNIOR OFFICER PANEL  
LIEUTENANT MARY C. COYNE, USN  
LIEUTENANT MICHAEL T. PLUMMER, USN  
LIEUTENANT KENAN WANG, USN  
LIEUTENANT FLEET R. WHITE, III, USN  
LIEUTENANT JAMES AYLWARD, USN**

VADM DONNELLY: Okay, folks, we're ready to start the junior officer panel if you could take your seats, please. We just selected at random five junior officers who have completed their sea tour and are assigned at various locations in the Washington, D.C. area. No special criteria were applied, they're all typically outstanding nuclear trained officers.

We haven't rehearsed this at all, but I'm going to open it up and I would encourage you to have a question loaded. After they introduce themselves we'll have a Q&A session. The ground rules are – and we'll start on your right, my left – and we'll just go across the whole table here. I'd like each of you to introduce yourself, tell us what your accession commissioning source was, tell us what ship you qualified on, what jobs you had on that ship and what job you're in now. We'll go down the line and then we'll start some Q&A.

LT FLEET WHITE III: Thank you, admiral. Good afternoon, everyone. My name is Lieutenant Fleet White, a 2012 graduate of the U.S. Naval Academy. I studied history and economics at the Academy. I ran track and field and went through the nuclear power training pipeline. My first submarine was the USS *Olympia*, SSN-717 out of Pearl Harbor, Hawaii. While on the *Olympia* I was the electrical assistant and the chemistry and radiological assistant. That's my bio in short.

VADM DONNELLY: And where are you now?

LT WHITE: I now work for the Secretary of the Navy as a White House and Congressional liaison officer in the Pentagon in charge of the



Secretary's correspondence, mostly with members of Congress and any other elected officials for his executive correspondence.

VADM DONNELLY: Great, thanks.

LT KENAN WANG: Good afternoon, everyone. My name is Lieutenant Kenan Wang and I graduated from the U.S. Naval Academy class of 2011. My first assignment was the USS *Louisiana* out of Bangor, Washington. My jobs onboard ranged from the engineering division officer all the way through weapons division officer. Currently I'm working OPNAV N52, the mine warfare branch, mainly oversight of unmanned vehicles, specifically Knifefish, also the mining portfolio.

LT MICHAEL PLUMMER: Gentlemen, I'm Tommy Plummer. I graduated from Auburn University in 2011. I just came to N97 off of the USS *New Mexico*, 779. I am the flag aide at N97, which it was pointed out earlier that Admiral billet is gapped, which gives me the best shore duty right now. Mr. Howes was here earlier, so I support him there.

LT MARY COYNE: Thank you, admiral. Good afternoon ladies and gentlemen. My name is Lieutenant Mary Coyne. I commissioned at the University of Notre Dame in 2012 via their ROTC program. I was actually the first woman to go to submarines from that school when it opened up in 2011. I qualified on the USS *Maine* as a 741 Blue, now just a combined crew. She's in the shipyard, where I was initially the main propulsion assistant and then I was the communications officer for two years onboard. Following that I have recently reported to George Washington University ROTC consortium. We house George Washington, Georgetown, Howard and Catholic, and I am an assistant professor, also known as professional cat herder for my shore duty. I'll also be starting grad school at Georgetown and I'm a White House social aide. Thank you for having me here.

VADM DONNELLY: Thanks.

LT AYLWARD: (Off mic). I graduated from the Naval Academy in 2012 and qualified on the USS *Tucson*. I served as the Damage Control Assistant (DCA) and right now I'm the oncoming deputy executive assistant for N97, so my job is better than Tommy's right now.

VADM DONNELLY: Great. Why don't we start from left to right and just answer for me what attracted you to the submarine force? Why did you make that your service selection?



LT AYLWARD: Sure, sir. The people and the missions were what attracted me. I had a summer cruise on the *Wyoming* when I was at the academy and I was blown away by the quality of both the officer and the enlisted. I loved how the people are challenged there every day. So the people and then the mission on *Tucson*. I got to do two missions on national security, and they're incredible. It's exactly why I joined the Navy. It was great.

LT COYNE: I had a bit of a unique experience because submarines weren't an option for me. After the first time I went on one in the summer of 2009, I distinctly remember the interaction with the enlisted sailors onboard the, I believe it was the USS *Rhode Island* that I went on, and how incredibly proud and interested they were in their work and sharing it with us.

It wasn't, as I said, an option for me in 2011 when I was actually living in Dublin at the time. It kind of came up as a great opportunity so I figured what the heck, I'm a Poly Sci major, we'll give it a try, and here I am. So it is by far and away, to answer the question, the people and the challenge that it provides in the community.

LT PLUMMER: I'll carry Mary's challenge point a little bit further. I wanted to maintain a career that had me scholastically challenged, but I also wanted to serve in the military. I think the submarine force is the perfect marriage of both of those.

I neglected in the very short instructions you gave us to list the jobs on the boat. I was the EA (Electrical Assistant formerly called the Electrical Officer), the DCA and then the ENG for a short period of time at the end. But I enjoyed everything that the engineering department had to offer. I liked power school and I liked prototype. What I think is unique about this community is just as difficult as it is to be a military officer, it challenges you in the engineering environment as well. So that's why I signed up and I definitely enjoy that aspect of it.

LT WANG: Originally my intention in joining the Navy was to fly airplanes. During my fleet summer one of my mates pointed out all the submarine experience and personnel expertise to me, so that got me interested in the submarine force. I had the opportunity to participate in all the communities across the fleet and just by seeing what the submarine community does, the mission sets and also just the people from the



enlisted personnel to the officers, that solidified my decision to choose submarines.

VADM DONNELLY: Great. Are you a first generation American, Lieutenant Wang?

LT WANG: Yes.

VADM DONNELLY: What is the nationality of your ancestry?

LT WANG: Chinese.

LT WHITE: I also, like everyone else, a large reason from my joining was my midshipmen cruises at the Naval Academy. I went into the Naval Academy not necessarily knowing what I wanted to do when I graduated. I had a plebe summer cruise on the *Maryland*, and then on the *Kentucky* and was just blown away, both by the enlisted and officer side. When it came time for me to decide, meeting many of the submariners that were on the Naval Academy yard, I was just highly impressed by all of them. But it was really those submarine cruises that sold me on it, sir.

VADM DONNELLY: Okay, so I'm getting the theme here that exposing midshipmen to submarines during their cruises is important. I already knew that, of course. I'll ask one more question and then open it to the audience, and anything is game. I'll ask, starting at this end, for you to give me the most satisfying thing about your sea tour.

LT AYLWARD: I'm going to have to say the most satisfying thing was actually leaving the boat. The gratification from the crew, just to see that I made an impact while I was there. Just getting to know the guys in my division over time and the farewell I got from them made the whole tour really worth it.

LT COYNE : Absolutely, I completely agree with Jimmy. It's knowing the face-to-face communications, letters I've received saying thank you for what you felt at the time was – you know, you were just kind of spouting hot air and maybe not making an impact. You don't see it yet. You only see it two years after the fact. It's being consistent and being present and taking care of people and looking out for your wardroom, especially the younger JOs that follow you, and knowing what a lasting impression you can have on a group of people. It's extraordinarily humbling, especially people as high quality as submariners. It's truly an honor and a privilege. I think time and distance is required in order to see that.

VADM DONNELLY: Well said.

LT PLUMMER: I think it's actually easier to answer this question in this forum because my dad and grandpa are both career Army guys, and for the life of them can't figure out exactly what it is that I do with my time. They ask this question a lot, what do you think is rewarding about it? So I talk to them about leading a watch team. I'm sure it's the same as leading a squad. I can't tell you that as I've never led a squad, but when you have a watch team that you built and it's your sonar supervisor and it's your COW and it's your pilot, your co-pilot – you guys are familiar with that term, it's like the chief of the watch in Virginia – and your quartermaster, there's this sense of pride and sense of ownership.

The boat is going in the direction that you picked. You're executing the night orders. That's an enjoyable experience, that's a unique experience. That's why I will continue to do this job, because there's nothing quite like building a watch team and then watching that watch team learn and thrive.

VADM DONNELLY: Great.

LT WANG: I completely agree with Tommy, it's the sense of family that you build with your watch team, specifically as your watch team exceeds and is able to accomplish the mission and do well in the drill. That really gives you a huge sense of accomplishment. The most satisfying experience I had during my last sea tour was on my last patrol.

We were almost at the end of the patrol and we were told we were getting extended for another month. It was a huge impact to the crew morale, especially with the material status on the boat, but together as a boat, me as one of the senior JOs, we were able to lead the crew and carry out the mission and essentially successfully complete the patrol and come back home safely. In talking to my peers outside of the submarine force, I think a lot of them had that similar type of responsibility and experience that I had. I really cherished it and talked to my wife and shared that special memory.

VADM DONNELLY: Great.

LT WHITE: I completely agree with everyone. The progression that I felt from when I first got – really when I first started the whole process, going through power school – I felt it by the time I left, getting to a submarine and not knowing very much. And then I left the submarine



while we were on a mission in the western Pacific. That progression, as both Tom and Jim mentioned, of leading a watch team, of seeing it through the deployment work up, and then being the one that is actually making decisions the consequences for which could cost people lives, it was quite an experience. That was probably it.

VADM DONNELLY: Thank you. I think the submarine force of the future is in good hands. Thank you very much, each of you.

(Applause).

## THE TRIAD HOW DID WE GET HERE AND WHERE ARE WE GOING?

BY RADM JERRY HOLLAND, USN, RET.

The implosion of the Soviet Union marked the disappearance not only of a threat but also of the political entity to be deterred. Strategic nuclear deterrent policy was left without legs and so has been dormant for twenty years. The rise of Vladimir Putin and his open rearmament programs in Russia and the entry of a nuclear armed and aggressive China into the great power arena come at the same time as the end of life of America's existing strategic weapons systems. Proliferation of nuclear weapons by non-friendly states adds new dimensions but does not change the basic dynamics of deterrence that demand viable and powerful strategic weapons and their delivery systems. Finally, the large costs of modernization of the nation's strategic nuclear forces demand attention from legislators, defense executives and military leaders.

These factors force the return of debate on the nature and composition of American strategic deterrent forces. In the theoretical discussions around these issues, propelled by the end of life of present systems, knowledgeable voices, careful reasoning and measured opinions are important – too important to be left to the academic and the inexperienced. For those naval officers who concern themselves with strategic deterrence and nuclear weapons, the need for forces other than those embarked in US submarines seems counterintuitive. The utility of weapons beyond those deployed in a secure, safe and flexible structure that possesses all the attributes for strategic deterrence is not easy to understand. Naval officers are not alone with this question. The utility of land-based forces has been questioned as far back as 1961 when the conclusions of the Strategic Air Command War Game that year recommended eliminating ICBMs.<sup>i</sup> However, other actors in these discussions remain convinced of their utility.

Today the technologies required for each of the TRIAD's delivery systems are well developed. The weapons themselves are fruits of eighty years of development and no longer need great invention. Alternatives to

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<sup>i</sup> Vice Admiral Jerry Miller, USN (RET), Naval Historical Foundation – Naval Submarine League History Seminar, Washington, D.C., 14 April 2012.



their current deployment and basing have been thoroughly examined – and rejected. Really old practitioners continue to ask questions, e.g. “... are you considering concealing the ICBM’s?”<sup>ii</sup> to which the answers are “No”. The result of this thorough examination and expertise on one hand and the end of life of the present systems on the other is an opportunity to remake the US strategic arsenal on a “Clean Sheet”. If no systems existed, what would be the most logical and most effective new one(s)? Participation in this discussion by persons knowledgeable about the various theories and facts is important- particularly in areas where many of the participants have little knowledge and no experience in pertinent issues, like the sea.

As with any issue reopened after being long dormant, those newly engaged need to ask, “How did we get here”? Theories about nuclear deterrence began to be formed in the late 1940’s when it became clear that the United States would not long be the sole possessor of nuclear weapons. American military strategy at the time was dominated by officers of the Air Force who grew up in the advocacy of “strategic bombing”. Airplanes appealed to the political leadership as a strategy that reduced the need for building a navy and having to maintain a large army.

Heirs to the technical research establishments built up during World War II were first to consider the situation in which the Soviet Union would also possess atomic weapons and delivery systems that eventually would threaten the United States. The RAND Corporation, a Federally Funded Research Center established during the war by the Air Force, housed the initial research on how to conduct a war in which nuclear weapons might be used. While RAND was the center point on theories, other institutions and academic enterprises joined as the “balance of terror” was explored and debated.<sup>iii</sup>

Well before nuclear deterrence began to be explored, the victors at the end of World War II seized the German ideas, equipment and personnel that had produced the V-1 cruise missiles and V-2 rockets used to bombard Britain. The services were slow to develop these systems because the nuclear warheads themselves were very large – airplanes were the sole delivery system. The Air Force began exploiting the V-2

ii Senator John Warner to Secretary of the Air Force, Cynthia Wilson, “Secretaries of the Military Department’s Panel,” CSIS, Washington, DC, March 12, 2018

iii Bernard Brodie, “Strategy in the Missile Age,” Princeton University Press, Princeton, New Jersey, 1959. Schelling, Wohlstetter, Kahn et.al.

but development was not encouraged by that service's leadership's attention to bombers. The land launched missile languished until 1957 when the Soviet launch of Sputnik added national impetus. The Navy created a carrier based large bomber to participate in the strategic nuclear weapons missions.<sup>iv</sup> Rockets, then liquid fueled, were considered too hazardous for shipboard and so attention turned to cruise missiles. Nuclear armed REGULUS cruise missiles went on patrol in submarines in 1955; deployments that lasted until 1964. With dramatic reduction in the warheads' size and weight, missile development accelerated in the Air Force and the Navy. The Chief of Naval Operations, Admiral Arleigh Burke, established the POLARIS program aimed at putting solid fueled ballistic missiles on submarines. By the late nineteen fifties the elements of the TRIAD were borne.

As the technologies grew, ideas about what an exchange of weapons would mean absorbed the interests of political scientists and related scholars across the country. Concerns of the uniformed military focused not so much on use or utility of the weapons as on force structure and technical improvements. The vulnerability of land based strategic forces became apparent in these studies leading to hardening the land-based missile launchers, relocating the bomber bases to southern states and constructing a series of warning systems. At the same time, the POLARIS Submarine Launched Ballistic Missile (SLBM) became the number one priority program in the Navy. By the beginning of the Reagan administration, the TRIAD, a "bastard child of inter-service rivalries" according to Frank Miller, was in place. But the vulnerability of basing anchored ashore was never solved; the many attempts to design such a basing mode all foundered on the physical realities that it could not move or if it could (train mobile), the required footprint was too large to be realistic. Unless the land-based forces were used to preempt (first strike) - an option that seems never to have been considered after General Thomas S. Powers retired from command of the Strategic Air Command in the early sixties<sup>v</sup> - every land-based force had to rely on a warning system and short fused command and control arrangements in order to "Launch Under Attack" (LUA).

<sup>iv</sup> Jerry Miller, "Nuclear Weapons and Aircraft Carriers: How the Bomb Saved Naval Aviation," *Smithsonian*, 2001.

<sup>v</sup> Lt Col Donald G. Morrow, USAF, "Strategic Crossroads, The Road Not Taken?," *Airpower Journal*, The Air University, Fall 1988.



Development of the ICBM and SLBM missile systems were not enthusiastically endorsed within their individual services. The Navy's aviation community violently objected when funds for a carrier were shifted to the POLARIS building program. The bomber wing of the Air Force was indignant at the diversion of monies from bombers to missile development.

Studies of the various basing alternatives through the sixties and seventies all demonstrated the survivability of the sea-based system. The Office of the Secretary of Defense, not knowledgeable in maritime matters, suspicious of the Navy's motives, and anxious to avoid the cost associated with the sea-based leg was not receptive to these conclusions. Repeated attempts to find a base for the land-based missiles that bolstered the economic arguments all lost in face of the utility (dependent on LUA) and survivability (none). When TRIDENT D5 SLBM was fielded with an accuracy equal to the land-based missiles, the final argument boasting that only ICBM's possessed "hard target" counterforce (able to destroy Soviet ICBM sites) lost purpose.<sup>vi</sup> However even after the D5 addressed the last advantage of the ICBM to achieve the purposes of deterrence, the three different delivery systems and basing modes each with its own advocates, vested interests, and performance criteria continued.

As the Soviet Union imploded and disappeared the value of strategic nuclear weapons decreased and senior leadership and attention in both civilian and military circles drifted away from nuclear weapons matters. What little public discussion of the nuclear strategic weapons that did exist focused on reduction of numbers of nuclear warheads. Evaluation and analysis of strategic weapons were reduced to a Congressionally mandated Nuclear Posture Review (NPR), ordered to be coincident with the quadrennial defense review. The NPR's aim was to be a "basis for establishing United States arms control objectives and negotiating positions."<sup>vii</sup> Regarding the TRIAD, the results of these reviews can be summarized as "Steaming as before".

This shift of attention reverberated through the Defense Department with unwanted results.<sup>viii</sup> Problems in the Air Force in inventory and deployment led to questions about how the Navy escaped these same

<sup>vi</sup> Owen Cote, "The Trident and the Triad: Collecting the D5 Dividend," *International Security*, Fall 1991, #22  
<sup>vii</sup> Public Law 110-181, 110th Congress, SEC. 1070. Revised Nuclear Posture Review.

<sup>viii</sup> "Review of DoD Nuclear Mission," *Report to the Secretary of Defense Task Force on DoD Nuclear Weapons Management, Phase II*, December 2008. [The Schlesinger Panel].



problems. Personal attention at the operating level, knowledge of technical details – a heritage of pre-World War II submarines reinforced by Admiral Rickover’s strict regimen, direct and immediate involvement of commanders at the basic organization levels and intrusive and demanding oversight by their superiors mark the Navy’s custody of nuclear weapons. Direct and personal experience in the operation and maintenance of nuclear reactors and in the custody and handling of nuclear weapons exists at every level of command. This personal involvement, while often a matter of jest by fellow officers outside this community who comment that, “The Navy’s nuclear weapons are managed by the most obsessive-compulsive organization in the world”, is nevertheless widely known and respected both in the Navy and by civilian scientists and political leaders.

Maintaining this reputation is critically important. The trust engendered in and by each person involved with development, maintenance and deployment of these weapons relies on continuing high standards of care for these world-ending devices. In coming years, the issue of the composition of the nuclear weapons related systems may become subject of serious debate. In those debates casual accusations of inadequacy and inferiority of the submarine based nuclear forces capability need to be answered whenever the subject arises. While less than 5% of the Navy’s personnel are engaged in the Strategic Deterrence Enterprise, this is the Navy’s primary mission requiring attention if not dedication from “all hands”. Every officer who has served at sea knows how hard it is finding and attacking submarines. This practical expertise is important in informing decision makers of the utility of the submarine-based component of the TRIAD and preventing perversion by weak or specious arguments. Such representation is important because currently attention on this aspect of our national defense centers only on their cost. This emphasis on the budget and national debt create the hazard of turning strategic nuclear weapons into an affair of accountants rather than of political leaders, strategic thinkers, social scientists and military officers.

Part of the campaign of advocates of land-based systems is inferring the missiles based at sea are in some ways inferior to those based ashore. A recent tract by Major General Roger W Burg USAF (Retired) published by the Air Force Association advertises the utility of strategic

deterrent forces based ashore.<sup>ix</sup> None of his arguments are new. Several errors and questionable assertions demonstrate an ignorance of the sea-based environment or technologies. Promoting the Intercontinental Ballistic Missiles (ICBM) and long-range bombers in his analysis, General Burg provides a list of attributes that can be helpful in identifying the aspects that emphasize the advantages of submarine based strategic weapons.

“The ICBM’s represent an unambiguous target. An enemy must attack these to try to limit damage to his own country. Such an attack would be apparent and the source identifiable as opposed to incremental reductions of submarines or bombers by secret or sneak attacks.” (*There exists no plausible threat to submarines underway at sea.*)

“ICBM fields are a weapons sink. An attack on these heavily fortified silos would largely deplete an enemy weapons’ inventory.” (*Missiles based in submarines provide no aim points.*)

“ICBMs high alert rates make them more responsive than bombers and submarines missiles.” (*Time on target is the operative metric. Because submarines can maneuver to shorten the time of flight SLBM’s time on target is substantially less than that of land-based systems.*)

“Land-based communications’ links provide faster response to orders than those to submarines.” (*Speed of response not a factor in deterrence; communications to submarines on alert are as fast or faster than to land-based sites.*)

“The 400 ICBMs are an offensive threat that can overwhelm any defense.” (*70% of US strategic warheads are based on submarines.*)

“ICBMs have a long history of reliability which will hedge against any disruption of one of the Triad’s other legs.” (*Only SLBM’s conduct end to end firing missions from operating launch platforms to target.*)

“ICBMs have the lowest operating costs and lowest recapitalization cost.” (*True.*)

“Because of their long slow flight times of bombers, weapons deployed in them are less threatening; thereby improving strategic stability.” (*Invulnerable, able to restrain action without losing ability to strike, SLBMs contribute the most to stability in confrontational situations.*)

“The visibility of bombers permits their use as a signal in confronta-

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<sup>ix</sup> Maj Gen Roger W. Burg, “America’s Nuclear Backbone, The Value of ICBMs and the New Ground Based Strategic Deterrent,” The Mitchell Institute, The Air Force Association, Washington, DC, 2017.

tional situations.” (*Not a unique property of bombers; many other forms of signaling exist.*)

Understanding that General Burg’s motive is to define the utility of the land-based systems vis-à-vis other systems, i.e., ones based at sea, his lack of comprehension of the sea, appreciating the complications of anti-submarine operations and understanding of long haul crisis communications are evident in what he sees as weaknesses of the sea-based system. His analysis of the merits of these forces does not contain any argument not aired in the 1980’s during the debates around MX Basing vis-à-vis the Submarine Launched Ballistic Missile (SLBM).<sup>x</sup>

One particularly fallacious aspect of these propositions is the assumption that speed is required to make deterrence work. This is a residue of the Launch Under Attack requirement in which the ICBM is grounded. Strategic nuclear deterrence does not rely on speed of response but on surety of weapons and will.<sup>xi</sup>

Long distance communications, the life blood of maritime operations at sea, are not well understood in the other services or the public in general. Unlike assertions regularly echoed by persons who are ignorant of the actual facts, independent studies since 1987 have determined that communications to submarines are as reliable and efficient as those to ground based forces.<sup>xii</sup>

That ICBM’s are needed as a hedge against failure of other legs of the TRIAD is based on the proposition that maybe someday anti-submarine measures will threaten the continued survivability of submarines. The wish that space-based technology would make the oceans transparent, a common hope hyped in the 1980’s, seems to have died, sunk by geography and physics. A new proposition that giant data bases might someday allow analytical determination of the submarine positions ignores the need for search vehicles to provide inputs on a real time basis. Operations analyses like this can and do work in relatively small areas with multiple sensors over short periods. Persons understanding sensor limitations and the probability of detection in large ocean areas realize

x Honorable Franklin Miller, Remarks, Naval Submarine League History Seminar, National War College, April 14, 2011.

xi Major Jeffery Zink, USAF, “The End of the TRIAD, Morality, Reality and the Ideal Deterrent,” *Naval War College Review*, Summer 1994.

xii Ashton B. Carter, “Communications Technologies and Vulnerabilities” in Ashton B. Carter, John D. Steinbruner, and Charles A. Zraket, eds. “Managing Nuclear Operations,” The Brookings Institution, Washington, DC, 1987.



that such measures are futile regardless of the size of the computer or its data capacity. There exists not even a vision of a mechanism that threatens the survivability of the submarines which operate avoiding detection as a priority.

The Nuclear Posture Review published this March offered an opportunity to evaluate how these various basing methods perform, how they compare in effectiveness and cost, and what future needs should be considered in their continuance and/or modernization. However, no alternatives to the current TRIAD were part of this policy review. The attributes of each of the three systems were restatements of those repeated in previous summaries.<sup>xiii</sup>

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These sorts of studies require the attention of persons who know and understand the sea, its vastness, cloak of invisibility and freedom for maneuver. Articulating these characteristics is not an easy task nor one performed well by persons who lack an experiential understanding, as

xiii "2018 Nuclear Posture Review - U.S. Department of Defense." <https://www.defense.gov/News/SpecialReports/2018NuclearPostureReview.aspx>.

General Burg demonstrates.

Regardless of technical propositions, the future of American strategic nuclear arms is in the hands of political leaders. For a myriad of reasons, the active duty components of the services will not willingly enter a public debate on the utility of arms of another service. The mantle of “Jointness” suggests that flag officers in joint billets in particular, e.g., COMSTRATCOM, but active duty officers in general, not comment on issues other than to “promote the Administration’s agenda” which currently appears to be modernizing all three legs. However, this “gentleman’s agreement”, should not inhibit those knowledgeable from avoiding explanations of the advantages of the sea-based leg. On the contrary, those singular facets of the sea-based systems that are unique to its utility need to be explained and promoted. Policy makers, most of whose experience with the sea involves flying over it, should not be left adrift without the experiential knowledge that comes from those whose life has been spent on, over and under the sea.<sup>xiv</sup>

When he promoted development of a strategic weapons system based in submarines, Admiral Arleigh Burke was accused of trespassing on missions assigned to the Air Force. The most authoritative military voices in the debate over MX Basing were Admirals Hayward and Watkins, Chiefs of Naval Operations, who questioned the theory behind the proposed basing schemes and the devotion of so much of the Defense Department’s resources to them.<sup>xv</sup> Their substantial grasp of the fundamentals of deterrence and alternative weapons systems shifted the country’s strategic focus from land to sea. As in times past, measured arguments and strong and experienced voices are needed to influence the next generation of these weapons’ systems.

The compromises that resulted in the TRIAD continue and probably will pass into the future because change requires more political energy and analysis than exists, at least at present. The Nuclear Posture Review summarizes the arguments for the TRIAD,

“The increasing need for this diversity and flexibility, in turn, is one of the primary reasons why sustaining and replacing the nuclear triad

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xiv Admiral Richard Mies, USN(RET), “Strategic Force Atrophy,” Naval Submarine League Conference, Arlington, Virginia, 19 October 2011

xv US Congress, “MX Missile Basing System and Related Issues: Hearings Before the Committee on Armed Services, United States Senate, Ninety-eighth Congress, First Session, April 18, 20, 21, 22, 26, May 3, 1983, pages 134 et seq.



and non-strategic nuclear capabilities, and modernizing NC3, is necessary now. The TRIAD's synergy and overlapping attributes help ensure the enduring survivability of our deterrence capabilities against attack and our capacity to hold at risk a range of adversary targets throughout a crisis or conflict. Eliminating any leg of the TRIAD would greatly ease adversary attack planning and allow an adversary to concentrate resources and attention on defeating the remaining two legs. Therefore, we will sustain our legacy triad systems until the planned replacement programs are deployed."

However, as costs mount, the modernization programs will come under greater scrutiny. The 2018 Nuclear Posture Review will not be the last. While the Air Force leadership might favor funding the new bomber at the expense of the ICBM, internal interests will continue to promote the ICBM leg and elected officials in the affected manufacturing and basing states will lobby hard for that missile system. Navy spokesmen cannot ignore these discussions or allow American political or economic concerns to work unchallenged to the detriment of maintaining the sea-based leg.

## THE FIRST SKIPPER PROBLEM

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*Note: This article was submitted in January 2018. —Ed*

The United States Navy is well known for publicizing removal of its commanding officers. In the last three months, five levels of the Pacific Fleet chain of command were either removed from command or told their careers were finished. While publicly announcing the removals, the Navy is also notoriously reticent in discussing them with any detail. Much of this derives from a deep seated cultural desire to not air dirty laundry. Some of it derives from a modern concept of privacy; some from an older concept of shame. And some part derives from the guilt associated with *schadenfreude* - the pleasure felt at someone's misfortune and the relief felt that the misfortune fell to someone else. The cultural approach to reliefs is such that very little is written about them, and because so little is written, what is written becomes writ.

Recent actions in the Pacific are not the Navy's first brush with command removal. Two previous spikes brought internal Navy investigations. Historically, removing commanding officers is unusual, but also not unheard of. Removal for operational or personal failings, was, and is, part and parcel of the business of going to sea and fighting a war. And, just like today, little of substance was written about the removals. There were no newspaper stories detailing the problems associated with naval command. No messages between commanders seeking solutions to any sort of 'skipper problem.' No guidance to the Fleet on improved professionalism, or to increase sleep. No added PowerPoint training.

At the start of World War II there were weightier issues to cover in the press and via message. However, as America and her Navy moved past the existential threat, actions poorly documented took on lives of their own and oral tradition filled in for fact. The first open recognition that there'd been any sort of problem came in 1975 with Clay Blair's seminal work *Silent Victory*. Blair combined contemporary war reports



with postwar data reconstruction and interviewed hundreds, if not thousands, submarine veterans. He greatly benefited from 30 years of post-war scholarship. He also suffered some from post-war nostalgia. Blair's work is the basis for the modern understanding of how WWII submarine skippers performed and typically any discussion of World War II, submarine commanders, warfighting prowess, leadership (or lack thereof), or commanding officer removal likely includes a comment along the lines that 'at the beginning of World War II a third of submarine commanders were relieved - generally because they were unaggressive or bad leaders.'

The conventional wisdom is simple: the undersea Pacific War went poorly until warrior skippers took command of submarines and purged the interwar era plans, procedures, tactics and mindset from the force. There's only one problem with this idea; it isn't true. Or at least the issue is far more complicated than the accepted basis that one third of COs were relieved. Blair's passage is oft referenced, but less often cited, and reads thus:

During 1942, the three commands [Commander Submarine Force Pacific Fleet, Commander Submarines Asiatic Fleet, and Commander Submarines Southwest Pacific] relieved about 40 skippers out of 135 - almost 30 percent - because of poor health, battle fatigue, or nonproductivity [sic], mostly the last.<sup>i</sup>

However, a modern review of patrol records, promotion patterns, and subsequent assignments for those skippers shows a different reality.

Blair mentions some reliefs by name but only clearly identifies 29 of the 40 he asserts were relieved in that first dark year. A review of patrol data from the San Francisco Maritime National Park Association and commanding officer names and assignments collated by Stephen Svonavec at [fleetorganization.com](http://fleetorganization.com) confirms a total of 29 reliefs for cause out of 131 submarine commanding officers; but only 29. If we stopped at the numbers one could argue there's no real discrepancy. 29 of 131, 22%, isn't as great a number as Blair's "almost 30%." So what? It's not until each relief is separated and addressed individually that the new picture emerges.

Yes, somewhere between twenty and thirty percent of submarine commanding officers were relieved for cause in 1942. However, while

i Blair, Clay Jr. "Silent Victory." New York: Bantam, 1975., 361



just under half of these officers were removed for not producing in most cases the issues were far more complicated than simple passivity. 10 were removed or requested relief over physical or mental health issues. Three were reportedly removed for bad planning or bad luck. Two were relieved for unrecorded causes, the reason and rationale lost to history.

More interesting, given Blair's statements, of the 14 commanders relieved for poor patrols in 1941 and 1942, five returned to command submarines later in the war. Four were awarded the Navy Cross for actions during those reportedly non-productive patrols. Additionally, in the first year of the war, there were almost 200 patrols - and 76 of them produced no attacks. Of those who attacked, only 64 had at least one confirmed sinking. In thirteen months of war, Pacific Fleet submarines had a one in three chance of firing a torpedo on patrol, and if a torpedo was fired there was a less than fifty percent chance of sinking a ship. However, only 14 commanders were relieved for poor patrols.

While Blair lays blame at the feet of non-producing COs, he also points out the inescapable facts these additional statistics show - there was more to the 'skipper problem' than just submarine commanding officers. Blair writes, in the next paragraph down from the issue of non-productivity that "[t]he major reason for the submarine failure of 1942 was not mechanical, physical or psychological. It was...a failure of imagination on the highest levels by King, Edwards, Nimitz, Hart, Wilkes, Withers, English, Lockwood, Christie, and Fife."<sup>ii</sup> This failure of imagination lay not only with prosecuting the war, but in what to do with officers in command. Some of that failure of imagination also lays with Blair, who either ignored or downplayed later contributions of some officers he specifically names. The divergence between Blair's statements and reality are well illustrated in the cases of Donald McGregor, Joseph Callaghan, and Morton Mumma.

Lieutenant Commander Donald John McGregor took command of USS *Gar* (SS 206) in April 1941. He led *Gar* through four war patrols, was awarded the Navy Cross for her first war patrol (February to March 1942) but patrols three and four resulted in no attacks and in November 1942 McGregor was removed from command. Between November 1942 and March 1943, he was promoted to Commander before taking command of USS *Seahorse* (SS 304) where in one patrol he made two

ii *ibid*, 361-2



attacks and was depth charged off Palau. On return to Midway, McGregor was removed from command after, Blair writes, his executive officer complained to Commander Submarines, Pacific that McGregor was “failing in his duty.”<sup>iii</sup> Command of *Seahorse* then passed to that same executive officer. As was common with most relieved commanders, Blair never mentions McGregor again. Records show that McGregor left submarines but was promoted to Captain before taking command of USS *Laurens* (APA-153) in 1944 and later commanding Service Squadron 1. He retired in 1956, after thirty years’ service, as a Rear Admiral. He died in 1982.

Lieutenant Commander Joseph A. Callaghan took command of USS *Porpoise* (SS-172) in June 1939. When the Japanese attacked, *Porpoise* was in the Philippines for refit. All four main engines were in various states of overhaul and her entire after battery was removed. In two weeks she was seaworthy and transited to Manila, beginning her first war patrol on December 22nd. Before ending her patrol a month later, *Porpoise* attacked two ships without result. During the patrol Callaghan suffered from extreme exhaustion. He told Blair “I have always considered that I had all the requisites for being a successful wartime submarine commander, except one: stamina. That was my undoing, the lack of it and total exhaustion I experienced may be attributed to it.” Like McGregor, Callaghan also had a poor relationship with his executive officer. In Callaghan’s war patrol report he placed blame for a poorly executed, and missed, shot, on exhaustion saying he would not have fired had he been in “full possession of his mental faculties.”<sup>iv</sup> Callaghan was relieved as soon as the war patrol ended. Command passed to Lieutenant Commander John McKnight. McKnight began the war in command of S-36, which ran aground in Makassar Strait. Damage was so severe that S-36 was scuttled. McKnight was not blamed for the incident.<sup>v</sup> Nor did he suffer for taking *Porpoise* into a typhoon. McKnight was eventually relieved of command, after making four war patrols. His first two were unsuccessful, however in his last two he made six attacks and sank two ships. Blair says of McKnight that he “found plenty of good targets, twenty-three in all...However, he failed to capitalize on his opportuni-

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iii *ibid*, 458

iv *ibid*, 168

v *ibid*, 169

ties. When he returned, Lockwood criticized him..."and "regretted" that McKnight had not attacked more targets. McKnight left submarines for good, going to communications duty." <sup>vi</sup>

Like McGregor, Blair acts as if Callaghan and McKnight drop off the face of the earth. Callaghan became the executive officer in USS *Holland* (AS-3) before taking command of USS *Hanover* (APA-116) in 1945 and USS *Oneida* (APA-221) in 1946. In 1953 he served as the Chief of Staff to the Commandant of the First Naval District. He retired as a Captain and died in 1988. McKnight might have gone to "communications duty" but he was also awarded the Silver Star for his service in command of *S-36* and *Porpoise*. By August 1943 he was in command of USS *Litchfield* (DD-336). In 1952 he took command of USS *Prairie* (AD-15). He retired in 1959 and died in 2002.

One of Blair's more egregious stories, and omissions, concerns Lieutenant Commander Morton C. Mumma, Jr. Blair spends two pages on Mumma's war patrol in USS *Sailfish* (SS-192). Mumma, Blair writes, was handpicked for *Sailfish* to overcome her previous bad luck and sinking as USS *Squalus* (SS-192). Blair concedes that despite Mumma's focus as a "strict disciplinarian", "strong personality" and "zeal, competence, and emphasis on spit and polish" the boat was "different" because of her experience as *Squalus*. On December 13, 1941, Mumma and *Sailfish* encountered two destroyers and submerged to make the approved pre-war doctrinal sonar approach and attack. *Sailfish* was detected and attacked, but still fired two torpedoes. The destroyers pressed their attack, dropping almost two dozen depth charges. Mumma, according to Blair, "went to pieces."<sup>vii</sup> He purportedly turned command of the boat over to his executive officer who immediately radioed higher command. On return to Manila, Mumma was relieved of command - and also presented the Navy Cross. Blair surmises the award was "designed to save everybody embarrassment" and then writes of how devastating being relieved of command is:

To fail in command usually spelled the end for an officer, denying him an opportunity for good jobs and advancement to flag rank. Mumma's humiliation before his classmates and fellow submariners was further heightened by the fact that he had no way to leave Manila for other

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vi *ibid*, 410

vii *ibid*, 143



duty. He had to remain and face them every morning. Many officers, especially the younger ones, were appalled by Mumma's conduct in war. No one could understand it. At the Naval Academy, they had been exhorted to "go in harm's way" and give their lives for their country. But they were soon to discover that Mumma was no isolated case. All too many of his contemporaries in the submarine force showed a disinclination to attack the enemy boldly and persistently, an unforeseen circumstance that would plague the submarine force throughout the war.<sup>viii</sup>

Again, Blair is both overstating, and understating, the issue. The Navy Cross is the second highest award for valor. The idea that this award might be presented "to save everybody embarrassment" is dubious. However, if one accepts the idea the award was given as Blair characterized, then one must also accept that Pacific command leadership saw greater issues than one commanding officer breaking down in combat - and those issues may have impacted relief rates. Mumma also soon returned to command. Mumma, whose conduct Blair called "appalling," commanded Task Group 50.1 - the PT boats in the Southwest Pacific. From 1943 through 1944 he led his boats from Papua New Guinea, supporting the Pacific advance.<sup>ix</sup> On his regular relief in 1944 he received the Legion of Merit and became the naval aide to the Secretary of the Navy, James Forrestal. He retired in 1946 but was recalled for the Korean War. After his second retirement, and tombstone promotion to Rear Admiral, he served as the president of the National Rifle Association before dying of cancer in 1968. A recipient of the Order of the British Empire, Mumma is also remembered via Mort Bay, Papua New Guinea, named in his honor and the NRA's Mumma Trophy which recognizes his and his father's contributions to the association.

These officers are not anomalies. Adrian Melvin Hurst commanded USS *Permit* (SS-178) for three years and two war patrols, the last of which resulted in three sunken ships. Hurst's tour was dogged with bad engines, multiple health issues among his crew, and one patrol with extra personnel where the boat ran short of food. He was relieved and disappears from "Silent Victory". The rest of his story includes command of an LST task group in the assault on Makin Island, promotion

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viii *ibid*, 144

ix Morison, Samuel Eliot. "Breaking the Bismarcks Barrier: 22 July 1942-1 May 1944." Edison, NJ: Castle, 2001. 53 and 372

to Captain and command of Naval Station San Diego. He died in 1975. Hamilton Stone was relieved of command after two years in USS *Snapper* (SS-185). He led two war patrols and was credited with one sinking. After leaving *Snapper* he moved among staff jobs before assignment as executive officer in USS *Orion* (AS-18). He later served as operations officer of a gunfire support group during the amphibious assaults on Iwo Jima and Okinawa for which he received the Bronze Star. After the war he commanded the Japanese Cruiser *Sakawa*, transferring her to Bikini Atoll for atomic bomb testing. In January 1947 he promoted to Captain and retired. He died in 1993. Stone's relief in *Snapper*, Harold L. Baker, was also relieved after two patrols but returned to command in USS *Cuttlefish* (SS-171). Edward R. Hannon commanded USS S-43 for more than three years before being relieved for "not producing." He returned to command USS *Dolphin* (SS-169) for almost two years before leaving submarines to command USS *Orion* (AS-18) as a Captain.

One early relief might surprise some because not only did the officer get a second chance at command, but he also became one of the most successful and decorated commanders of the war. Dudley "Mush" Morton was relieved for cause in 1942 by Captain John Haines, commander Submarine Division 42, who described Morton's command, USS *Dolphin*, as "filthy and [that] Morton [was] incompetent to fix it." Morton agreed, reportedly telling his executive officer that "The *Dolphin* is a death trap. I'm going to try to get off her. I advise you to do the same."<sup>x</sup>

Rescued by another senior officer who knew him, largely because they'd both played football at the Naval Academy, Morton returned to command only a few months later. Morton commanded USS *Wahoo* (SS-238) through four war patrols. This sinking record in four patrols placed him third in post war tallies and earned him four Navy Crosses; a record he compiled in less than a year before *Wahoo* was lost with all hands on her seventh war patrol (Morton's fifth as commander). Despite his successes, Morton had one patrol where he returned after making six attacks but without sinking a single ship. Even the most successful commanders had bad, or unproductive, patrols.

Morton's success in *Wahoo* eclipsed his problems with *Dolphin*. Today Morton is one of the best known and celebrated Pacific War submarine commanders. In 1960 Vice Admiral Charles A. Lockwood, Jr.,  
x Blair, Clay Jr. "Silent Victory." New York: Bantam, 1975., 251



wrote about Morton:

When a natural leader and born daredevil such as Mush Morton is given command of a submarine, the result can only be a fighting ship of the highest order, with officers and men who would follow their skipper to the Gates of Hell.... And they did. Morton lined up an impressive number of 'firsts' during the short ten months that he commanded *Wahoo*: first to penetrate an enemy harbor and sink a ship therein; first to use successfully a down the throat shot; and first to wipe out an entire convoy single-handed.<sup>xi</sup>

Lockwood commanded submarines throughout the war culminating as Commander, Submarine Force Pacific from 1943 to 1946. During 1942 and 1943 he personally relieved at least 8 skippers for a variety of reasons. His epitaph for Morton stands in stark contrast to John Haines' words. Who was right? Was either wrong? Lockwood, despite authoring over eight books about submarine operations during the war, never directly addressed the skipper problem, which leaves historians wanting for an explanation of the difference.

Morton's experience is one extreme of this "skipper problem" but is not an extreme in isolation. Morton's predecessor in *Wahoo*, LCDR Marvin G. Kennedy, was relieved for not being aggressive enough. He left submarines and after a tour as repair officer in USS *Bushnell* (AS-15) he took command of USS *Guest* (DD-472) and was awarded the Silver Star for action in Guam, the Palau Islands, and The First Battle of the Philippine Sea - an action Blair acknowledges. The award was his second Silver Star - he also earned one while in command of *Wahoo*, on the same patrol for which he was later relieved of command for not being aggressive enough.

In addition to John McKnight and S-36, at least four other commanders ran their submarines aground. One, Albert Bontier, was removed after grounding USS *Razorback* (SS-394) during her 1944 shake-down cruise but returned in command of USS *Seawolf* (SS-197) only weeks later. The other, William N. Wylie, was removed after grounding USS *Scorpion* (SS-278) in 1943. Wylie left submarines and went on to command USS *Stormes* (DD-780). He was awarded the Navy Cross during his first submarine war patrol and later the Silver Star for ac-

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<sup>xi</sup> Sterling, Forest J. "Wake of the Wahoo: the Heroic Story of America's Most Daring WWII Submarine, USS *Wahoo*." Placentia, Ca.: R.A. Cline Pub., 1999., 8

tions during the Battle of Okinawa while in command of *Stormes*. He was promoted to Captain prior to retirement and died in 1960. In 1942, Lieutenant Commander Francis Brown ran S-39 aground and she was so damaged the crew eventually abandoned ship. While there were recommendations that Brown receive court martial, he was actually moved to command another submarine, S-43. In 1944 Lieutenant Commander John D. Crowley ran USS *Flier* aground on her maiden patrol while entering Midway harbor during a storm. During the attempted recovery submarine rescue vessel USS *Macaw* also ran aground, broached and sank killing her commanding officer and four crew. Crowley took *Flier* to San Francisco for repairs and remained in command. He returned to sea, completed one war patrol and was awarded the Navy Cross. One her second patrol *Flier* sank, likely from striking a mine between Borneo and the Philippines. He and seven crew members survived nearly a month on Palawan Island before rescue. Crowley retired as a Captain and died in 1997.

The numbers and stories presented here largely focus on 1941 and 1942, the timeframe Blair is most critical of. In 1943, 18 Pacific Fleet submarine skippers were relieved and in 1944 there were eight. These numbers all belong in context.

In five years of war, over 700 individual officers completed over a thousand command tours. In total only 60 officers are clearly identified as relieved of command — less than 10 percent. Of those 60, 25 returned to command, some in submarines, some in surface ships. Of those who returned to command, many continued on to major command and flag rank. Eight became executive officers in submarines and surface ships, and the remainder continued in staff positions. In the end, only two commanders, of 700, left the service after their reliefs and in both those cases severe mental illness manifested in command carried past the relief.

As for timidity or non-producing, in over 1700 submarine patrols in the Pacific and Atlantic Oceans, 545 patrols were completed without an attack. 446 were in the Pacific Ocean. In the Atlantic, of 114 patrols only 5 resulted in ship sinkings. No Atlantic commanders are documented as removed for non-productive patrols.

Conversely, there were only 21 patrols with 10 or more attacks. The names in these patrols are legend, as they should be. O’Kane, Fluckey,

Underwood, Klakring, Nimitz (Jr), and Morton. However, when ordering these high attack patrols by date a new picture appears. 1942 had only three patrols with 10 or more attacks (R. E. Moore in *Stingray*, F. W. Fenno in *Trout*, and T. B. Klakring in *Guardfish*). These 35 attacks resulted in 13 ships sunk and two more damaged. By comparison, in 1944 there were 11 patrols with 10 or more attacks totaling 120 attacks for 65 ships sunk. Essentially, early war commanders were not producing - for many reasons. Relieving 29, or 40, did little to change the odds.

It's time we put to bed the idea that early World War II submarine commanders were not aggressive, non-producing or acted cowardly. Some may have been, but more probably they were only doing as trained - acting as ordered. In order to understand today, to know what our actions today may cause "we must first understand our history — how we got to where we are." <sup>xii</sup>

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xii Richardson, John. A Design for Maintaining Maritime Superiority 2016



**THE TRAGIC LOSS OF THE NUCLEAR SUBMARINE  
*THRESHER*  
10 APRIL 1963**

**BY CAPT ZACK T. PATE, USN, RET.  
RADM DAVID GOEBEL, USN, RET.  
AND VADM GEORGE EMERY, USN, RET.**

The USS *Thresher* (SSN-593) was the first in a new class of deep diving fast attack nuclear submarines. She was constructed in the Portsmouth Naval Shipyard in Kittery, Maine. By early April 1963 *Thresher* had completed her “Post Shakedown Availability” (PSA) and went to sea for PSA sea trials.

As part of those sea trials a dive to test depth was scheduled. *Thresher* did not recover from the deep dive and sank to the ocean floor at a depth of just over 8000 feet. All 129 persons on board died instantly when the ship’s hull collapsed/imploded at a depth estimated to be at least 150% of test depth.

Extensive investigations were conducted in the following weeks and months, including by a Navy Board of Inquiry, which was promptly established at the shipyard, and later extensive congressional hearings were held.

The only other US nuclear submarine that has been lost at sea is the USS *Scorpion* (SSN-589), which sank in the mid-Atlantic on 22 May 1968. While there has been much research and speculation, the cause of the loss of *Scorpion* is still a mystery. A battery explosion is often cited as a factor, but the cause of the battery explosion is unknown. The cause of the loss of *Thresher* is much better understood for two principal reasons: *Thresher* had an escort ship and a SOSUS (off shore Sound Surveillance System) array was located in relatively close proximity. In *Thresher*’s case that array was on the ocean floor south of Nova Scotia, and about 30 nautical miles from the accident site.

Virtually all information about the tragedy was quickly classified, including the report by the Board of Inquiry, congressional hearings, SOSUS data, as well as the underwater telephone (UQC) communications with the escort ship, USS *Skylark* (ASR20). This information was



de-classified (slowly and piecemeal) over time and now only minor details remain classified.

Much has been written about the tragedy, especially since the de-classification of the records began. In the view of the three co-authors of this article, there is of yet no short, easy to comprehend account that is both as factual as possible and unbiased. The three co-authors have studied and discussed the available history extensively and have sought to achieve just such an account. Here is our analysis of *Thresher's* deep dive and loss.

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*Thresher's* final 25 minutes:

0853 *Thresher* reports her depth (test depth -300 feet), going to test depth, to her escort ship, USS *Skylark* (ASR-20), on the Under Water Telephone (UQC).

0902 *Skylark* reports to *Thresher* on the UQC that she is changing course to 090 degrees.

At about this time, plus or minus a few minutes, *Thresher* reaches test depth.

0909 The Sound Surveillance System (SOSUS) detects what analysts describe as "line frequency instability". This most likely means that *Thresher's* Ships Service Turbine Generators (SSTGs) were not stable at 60 Hz, as they normally are.

0909.8 SOSUS detects what some analysts describe as a main ballast tank (MBT) blow of 1.5 minutes duration.

0910 *Thresher* reports a course change in what appears to be a routine UQC communication. Since the report was made without alarm the classification of the noise detected by SOSUS at 0909.8 as a MBT blow is questionable. Additionally, *Skylark* did not report detecting MBT blow noise at this point, but both SOSUS and *Skylark* did detect and reported MBT blow noise three minutes later.

As has been described in other sources (Note 1), attempts by *Thresher* to blow main ballast tanks were so ineffective that VERY little water was being displaced from the ballast tanks, and the air flow through the ship's airlines was only a small fraction of designed air flow. Thus, the noise transmitted to sea could be very different than the noises detected by SOSUS in other MBT blow situations.

0911 SOSUS detected *Thresher's* Main Coolant Pumps (MCPs) stopping. (SOSUS had detected MCPs running in fast speed earlier in the dive). The loss of MCPs in fast speed could be due to instabilities in SSTG output, as noted by SOSUS two or so minutes earlier, or due to a reactor scram. In any event, a reactor scram almost certainly occurred at this point.

The abrupt stoppage of Main Coolant Pumps (without the normal procedure of first shifting the pumps to slow speed) would cause an immediate reactor scram as the reactor protection circuitry detected a complete loss of flow. The reactor scram could also have been caused by salt water spray from leakage from any one of the MANY sea water valves / fittings / flanges / sil-braze joints / valve stem packings / etc. located in the machinery space. The machinery space on *Thresher* was located between the reactor compartment and the engine room and contained extensive sea water system piping. Reactor control electronics and the AC/DC motor generators were located in this space.

The ship has now lost all propulsion. Shifting propulsion to the ship's Emergency Propulsion Motor (EPM), a low powered electric motor wrapped around the shaft to the propeller, was a slow process. Shifting to the EPM required dis-engaging a massive clutch in the shaft so that the EPM would be turning just the propeller and not the main turbine rotors and the reduction gears. On *Thresher* this had to be done locally, at the very stern of the ship. And, at that point in history, Naval Reactors procedures did not make provisions for use of residual heat in the reactor for propulsion.

0912 *Thresher* responded to a UQC transmission check from *Sky-lark* without expressing alarm. Both ships used the code word "KILO" meaning that communications were satisfactory. At that point, however,



the Captain and Officer of the Deck, both in the Control Room, would very likely have been getting alarming and, at least at first, confusing reports from the Maneuvering Room, located aft in the engine room.

0913 *Thresher* reports on the UQC: “Experiencing minor difficulties. Have positive up angle. Attempting to blow up.” This transmission is thought to have been made by the Commanding Officer.

The ship was using coast down speed after the scram to plane up and was likely able to get at least a few feet above test depth. The ship was heavy from sea water leaks and possibly from being out of trim---not noticeable at 10 or 12 knots, but very noticeable at 2 or 3 knots.

0913.5 *Skylark* and SOSUS both “...detected noise thought...” to be from *Thresher*’s attempt to blow Main Ballast Tanks. The noise had a duration of 30 seconds. With no propulsion and an ineffective MBT Blow System -- and heavy -- the ship was slowly sinking,

0916 *Thresher* reported “exceeding test depth” on the UQC. (In this transmission the words “test depth” were clear while the first word was garbled; but widely thought to be “exceeding” or “passing”.)

0918.1 *Skylark* and SOSUS heard the hull implode, instantly killing 129 souls.

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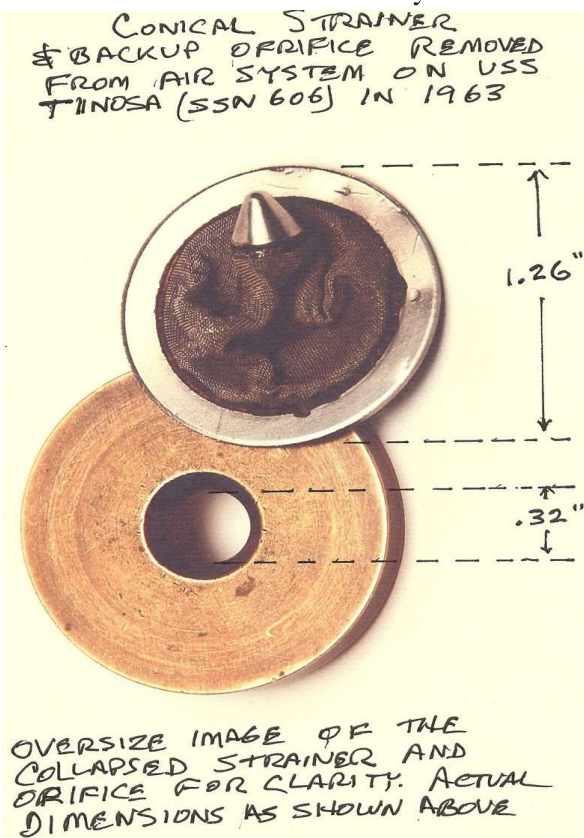
Notes: (1) In a letter and statement of analysis to the president of the Submarine Museum and Library, written on the 50th anniversary of the loss of *Thresher*, retired Captain Zack T. Pate describes experience on *Thresher*’s sister ship at the shipyard, the USS *Tinosa* (SSN-606), which provides data and physical evidence that convincingly demonstrate that *Thresher*’s Main Ballast Tank blow system was seriously degraded. The principal cause of the degradation was “temporary” strainers in the air system that collapsed. Fine mesh conical strainers, backed by a thick bronze plate with a small orifice, were installed by the shipyard to protect air system valves from minute particles of debris during construction. The strainers were not removed before the ship went to sea, as intended,

and the conically shaped mesh collapsed into the back-up orifice, blocking air flow to the main ballast tanks. See the photo below. The aforementioned letter and statement are included in this issue of *The Submarine Review* and are also available at the Submarine Library and Museum Association in Connecticut.

(2) The authors do not believe that *Thresher* suffered a major flooding casualty, as suggested by the Navy Board of Inquiry. SOSUS experts believe that the noise from major flooding at test depth would have been unmistakable at the (fairly nearby) SOSUS array and, in addition, the report by the Captain of “experiencing minor difficulties” is inconsistent with major flooding. No submariner considers flooding a minor event. We do

believe, however, that it is likely that *Thresher* experienced sea water leakage and, that even a relatively small leak at test depth could cause considerably spraying of salt water onto electrical and electronic equipment. We consider that a probable cause of the frequency instability detected by SOSUS and, directly or indirectly, of the reactor scram.

(3) In this article the authors have not sought to assign responsibility / accountability. We believe, however, that there is plenty to go around,



and that the shipyard is certainly not exempt.

All three co-authors served in the Navy's nuclear submarine program as the principal part of their career. VADM Emery served as Commander Submarine Force Atlantic before retiring. RADM Goebel served as Commander Submarine Group Two and now, in retirement, serves as President of the Submarine Library and Museum Association in Connecticut. CAPT Pate served as a special assistant to Admiral Rickover before retiring.

CAPT Pate's first assignment on a nuclear submarine was as Auxiliary Division Officer on USS *Tinosa* (SSN-606), the sister ship to *Thresher* at the Portsmouth Naval Shipyard. After *Thresher's* loss then LT Pate was given a special assignment by his commanding officer to serve as liaison to the Navy Board of Inquiry and with shipyard engineers in the search for the cause of *Thresher's* loss; AND in the intensive quest to make sure *Tinosa* did not suffer the same fate. *Tinosa* did extensive tests alongside her pier at the request of the Board of Inquiry, especially of the Main Ballast Tank Blow System. (see Note [1] above).

**CAPTAIN Zack Pate's letter to RADM Goebel on the subject of the Main Ballast Tank blow system investigation following the loss of the USS *Thresher***

May 31, 2013

RADM David Goebel  
771 Pequot Avenue  
New London, CT 06320

Dear Dave,

The purpose of this letter is to forward a strainer (and its associated orifice) which was removed from the 4500/3000 psi air system on the USS *Tinosa* (SSN-606), shortly after the loss of USS *Thresher* (SSN-593) in 1963. *Tinosa* was *Thresher's* sister ship, under construction at the Portsmouth Naval Shipyard, when *Thresher* was lost at sea on 10 April 1963. The *Thresher* was the first ship of a new class.

The Court of Inquiry, formed to investigate the loss of *Thresher*,

asked *Tinosa* to conduct tests of the main ballast tank blow system shortly after the court was formed. At the time I was the Auxiliary Division Officer (aka Damage Control Assistant, or DCA) on *Tinosa*.

When the main ballast tank blow system failed to operate as designed, auxiliaries working for me soon located collapsed strainers just upstream of both 4500 to 3000 psi (Marotta) reducing valves. The collapsed strainers were quite clearly blocking most air flow to the main ballast tanks, as is evident from a visual inspection of the enclosed strainer, one of the two removed after the test. The two strainers were virtually identical in appearance and condition.

After the (failed) air system tests on *Tinosa*, I was interviewed by CAPT Osborne, a member of the Court of Inquiry. During our discussions I showed him the two collapsed strainers and where they came from in *Tinosa*'s systems. At the end of the interview I gave one of the strainers to CAPT Osborne to be part of the court's evidence. With the approval of my commanding officer I kept the other one "until further notice."

Now, 50 years later, and near the 50th anniversary of the tragic loss of *Thresher*, our sister ship, I am pleased to donate this second strainer to the Submarine Force Library and Museum Association.

Immediately following my signature on this letter is my "testimonial", as you requested, describing key aspects of the special tests on *Tinosa*, which I personally supervised, and other directly related observations.

The strainers were supposed to be a temporary installation, intended to protect the Marotta reducers during construction. There is abundant evidence that the strainers found on *Tinosa* were still installed on *Thresher* on the fateful day of her loss.

In my view the strainers were a significant, if not critical, factor in *Thresher*'s inability to recover from problems encountered during her deep dive. After reading the testimony below, I believe most readers will agree.

Warmest Regards,  
(orig. signed)  
Zack T. Pate  
CAPT. USN Retired



**Observations related to the loss of  
USS *Thresher* (SSN 693) on 10 April 1963**

One of the few communications (by underwater telephone) from *Thresher* to the accompanying Submarine Rescue Vessel (ASR), during her fatal deep dive, was “experiencing minor difficulties, attempting to blow”, thought to be transmitted by the *Thresher*’s commanding officer.

In addition to this evidence of a problem, the SOSUS recordings during *Thresher*’s deep dive showed a pattern of intermittent noise that suggested interruptions of air flow.

Based on this information (and perhaps other factors), the Court of Inquiry asked *Tinosa* to conduct tests of its main ballast tank (MBT) blow system.

*Thresher* was the first submarine to have 4500 psi air banks (cylinders located in the MBTs).

The previous maximum was 3000 psi and prior submarines had 3000 psi air systems running throughout the ship, without a need for reducing valves.

All of *Thresher*’s (and *Tinosa*’s) air systems were also 3000 psi; but two large 4500/3000 psi reducers served the 3000 psi systems from the 4500 psi storage cylinders. Thus, the 3000psi air used to blow the MBTs when surfacing went through these 4500/3000 psi reducers.

When *Tinosa* was preparing to fully test the MBT blow system alongside a pier (*Tinosa* was not yet ready for sea, but the air systems had been completed), a team of Shipyard engineers was assigned to help us with instrumentation, recording, etc. Through this team, the Shipyard expressed concern that a full pressure blow of MBTs alongside a pier (rather than submerged) might bulge or even rupture the MBTs.

For this reason, *Tinosa*’s first test of the MBT blow system was done with only 500 psi in the 4500 psi air banks; and instrumentation was placed on a MBT vent cover, topside on the ship, one forward and one aft.

[Note that this concern by the Shipyard is compelling evidence that a full test of the MBT blow system was not scheduled or conducted on *Thresher* before she went to sea. And, in fact, no such test was scheduled or planned for *Tinosa* at that point in time.]

When the test was conducted on *Tinosa* with 500 psi in the air banks,



there was essentially no measurable back pressure in the MBTs during the test.

The test was once again conducted with 1000 psi in the air banks, and once again the back pressure in the MBTs was nominal; about 1 psi as I recall.

*Tinosa* was then authorized by the Shipyard to do the full pressure test requested by the Court of Inquiry; and we charged all air banks to 4500 psi. With the air systems instrumented, including timers, we then conducted the full blow test simulating what a submarine would do at sea in an emergency.

When the MBT blow valves were opened on order there was a huge rush of air noise in the control room, then silence after a few seconds. Than a few seconds later another brief rush, then silence again. This pattern was repeated over about a six-minute period until the blow valves were closed and the test terminated.

Air pressure in the air banks had only dropped a few hundred pounds; to about 4100 psi as I recall.

We were shocked. The engineers and *Tinosa* personnel expected the air banks to be depleted in two or three minutes. We had witnessed less than one-tenth of the simulated deballasting (removal of sea water from the MBTs) that we expected.

An auxiliaryman who was stationed in the space where the two 4500/3000 psi reducers were located quickly reported that the reducers and upstream piping were covered in ice. The cause of the icing and reduced air flow was soon found --- a strainer installed upstream of each reducer had collapsed, effectively blocking over 90% of the expected air flow.

No *Tinosa* crew members, officer or enlisted, were aware that the strainers were installed --- nor were any of the Shipyard personnel involved in the testing.

We were subsequently advised by the Shipyard that the strainers were installed at the request of the Marotta Valve Company because construction debris was interfering with the ability of the reducers to completely shut off air flow, thus tending to over-pressurize the 3000 psi air system. The strainers were supposed to be removed before the ships went to sea.

The strainers were conically shaped (before collapsing), pointed into the airstream, and were backed by a thick brass or bronze orifice with a small center hole (about  $\frac{1}{4}$  inch diameter). The purpose of the orifice was to reduce the pressure differential across the strainer, so it would not collapse.

This worked during extensive routine use of the 3000 psi air system on *Tinosa* and during the MBT blow tests with 500 psi and 1000 psi in the air banks. But when the full pressure MBT blow test was conducted the strainers collapsed.

Thus, this observer's impression is that the strainers on *Thresher* may have collapsed when an emergency blow of MBTs was commenced or may have been already collapsed or partially collapsed as the collapsed strainers would pass enough air for routine 3000 psi air service and for a brief burst of air when surfacing from periscope depth when the Low Pressure Blower was the primary means of deballasting. So, it is quite possible that *Thresher* had been operating with collapsed or partially collapsed strainers for some time.

There was abundant evidence that the strainers were installed on *Thresher*, including:

- SOSUS patterns that showed the intermittent bursts of air noise as ice formed in the collapsed strainer and then blew out, then reformed, etc.; closely matching the pattern seen during tests on *Tinosa*.
- Testimony by Shipyard personnel to the Court of Inquiry that the strainers were installed on the *Thresher*.
- *Thresher* Captain Wes Harvey's statement "attempting to blow" on the underwater telephone
- The presence of the strainers on *Tinosa*

In assessing the impact of the degraded MBT blow system on *Thresher*'s attempts to reach the surface, it is important to understand the role of the propulsion system. Normally, a "Full Bell" (quickly resulting in high speed of the ship's propeller) would result in a rapid drive toward the surface. The data available strongly suggests that the reactor scrammed early during *Thresher*'s plight, and high levels of thrust from the propeller were not available. Subsequent to the loss of *Thresher*, *Tinosa* conducted tests (as did other ships) showing that use of decay heat from the reactor could provide a moderate level of propulsion for a

few minutes after a scram – enough propulsion to be an important asset in an emergency such as *Thresher* experienced. But this capability was not available to *Thresher*. Naval Reactor’s procedures did not permit use of decay heat at the time. (Soon after the *Thresher* loss, the procedures were changed.)

Indeed, on *Tinosa*, and I expect on *Thresher*, the scram procedure required the upper level engine room watch to trip the main turbine inlet valves locally--- to be re-set only after a full recovery from the scram, at least 20 or 30 minutes later. The Captain of *Thresher* most likely did not have the option of overriding procedures and using propulsion anyway.

Thus, the Main Ballast Tank blow system was the only means of bringing the ship to the surface, and the evidence is strong that it was seriously degraded. When one inspects the enclosed strainer, disabled may seem more accurate than degraded.

#### NOTES:

1) During the tests of *Tinosa*’s MBT blow system, the question arose as to whether the results of a full blow test on the surface at dockside would closely simulate a full blow at or near test depth. The shipyard (and BUSHIPS at the time) determined that flow to the main ballast tanks would be limited by “sonic choking” in the relatively small 3000 psi air lines to the MBTs; not by back pressure in the MBTs.

2) Three colleagues, who were shipmates on *Tinosa* during the period under discussion, reviewed this letter and the above observations and assisted in the quest for accuracy. These were:

- a. Clarence E. (Ed) Moore, CAPT. USN retired. Ed was Chief Engineer on *Tinosa*
- b. William D. (Bill) Smith, ADM. USN retired. Bill was Electrical and Reactor Control Officer on *Tinosa*
- c. Walter J. (Walt) Coakley, CAPT. USN retired. Walt was Weapons Officer and an Engineering Officer of the Watch on *Tinosa*



## REMEMBERING *SCORPION*

BY CAPT MARK GOLDEN, USN, RET.

I reported to USS *Scorpion* (SSN-589) as a young ensign straight out of the Academy, nuclear power training and an abbreviated sub school, in August of 1961. *Scorpion* had recently completed her post-shipyard availability. The crew and wardroom were very close, having just worked together on new construction testing and operations, and were very familiar with the ship.

Our Captain was Commander Buzz Bessac, who had not moved his family to Norfolk after building at EB, and so lived on board. Captain Bessac assigned his two new ensigns, me and my Naval Academy classmate Jim Patton, to two jobs each, one forward and one in engineering. I got Commissary and Auxiliary Divisions. My mentors were LT Bob Fountain, former Commissary Officer, and our Engineer, LT Buell Balderston. Additionally, Jim and I both had to qualify as OOD, EOOW, and in submarines.

*Scorpion* at the time was the latest and greatest in submarines. I had taken my first class midshipman cruise on a diesel boat, USS *Sea Cat* (SS-399), but this was a whole new experience. *Scorpion* had the new streamlined *Albacore* hull, was only 252 feet long, and could maneuver quietly in a fairly tight circle with only five degrees rudder. Her S5W nuclear steam propulsion plant, coupled with an HY 80 hull, opened up high speeds and for then, deep operations. Captain Bessac loved to demonstrate maneuverability to (usually VIP) riders by having the planesmen stand behind their chairs while changing depths in deep waters using the automatic depth control system. Both planes would immediately swoop into full dive positions like an eagle flapping its wings, and then gradually ease off, as the sub almost instantaneously slipped onto its new depth.

As I recall, the ship was not submerged from the bridge, as were *Nautilus*, which had been my sub school boat, and *Sea Cat*. The OOD and lookouts were brought down to Control Room and submerged from there. Hull openings were shown as red circles [open] or as straight red lines [closed], not the “green board, red board” panels of *Sea Cat*. But we still had and used a negative tank. When you flushed a toilet, you did

so with sea water at full pressure of the depth of the ship, as were all the sea water systems throughout the ship.

In the day, atmosphere control was not where it is today. One of my early jobs as Auxiliary Division Officer was to work with NAVSEA and a commercial oxygen supplier and do the first loadout of high pressure oxygen into our large banks. Submerged, this was bled into the ship through reducers to maintain breathable air, or else oxygen candles had to be burned. The CO burners were under-sized and had to be continually worked with. The CO<sub>2</sub> scrubber worked fine, as did the air conditioners.

My first senior commissaryman was PO<sub>2</sub> English, who with one other cook served up four meals a day to the crew and Wardroom. He ordered and supervised the storing of food for two month underways submerged. With the small size of the ship, cases of non-refrigerated foods were stacked throughout the passageways forward of the engineering spaces. Cases of eggs were stored in the Torpedo Room bilges for cooling. One time I recall we were extended on patrol to something like 76 days. My predecessor had loaded an off-the-books ample supply so that we were in good shape with food for the extension. However, when I brought the commissary returns to the Captain for signature, without a reload ability at sea, I had to reflect accountability for all the stores, which made it look like we did not use all our allowance of dollars. There was no way I was going to explain this to the Captain! Later in my career, I was most enthusiastic about having Supply Corps officers on board to deal with all commissary matters.

The more senior officers on board mostly had very prominent careers. Bob Fountain made rear admiral. Our first XO, Ken Carr, made vice admiral, and was COMSUBLANT. Buelle Balderston became the skipper of USS *Tautog* (SSN-639). Jerry Holland also made rear admiral, and our second XO, Carl Trost, made admiral. Our second CO, R.Y. "Yogi" Kaufman, made vice admiral. While I was on board, *Scorpion* earned a Navy Unit Commendation. Many of the enlisted crew also went on to successful careers, many making E-8 and E-9, earning commissions as LDOs, and going through college under the Navy Enlisted Scientific Education Program (NESEP) to earn commissions.

Jim Patton and I both qualified in submarines on board, and made LTjg, XO LCDR Ken Carr and navigator LCDR Dick Lumsden moved

on to become Blue and Gold Executive Officers of new construction USS *James Monroe* (SSBN-622), recruiting Jim and me to join them. Jim went on to command USS *Pargo* (SSN-650) and I went on to command USS *Tecumseh* (SSBN-628).

None of the Chiefs at the time wanted to be Chief of the Boat, so Gunners Mate 1, Wally Bishop volunteered, converted to TM1, and later advancing to CPO. Somehow, he and QMCS Mazzuchi managed to stay with *Scorpion* and were lost with the ship, with all hands, in 1968. At the time of the loss I was stationed in Madrid, Spain, as an Olmsted Scholar. This year marks 50 years since the loss, and former crewmen and families will commemorate the loss over Memorial Day Weekend in Norfolk. This time I will be able to be in Norfolk to join the families and former shipmates.



USS *Scorpion* Change of Command, with CDR. Kaufman relieving CDR. Bessac. COMSUBLANT VADM Grenfell is to the left of CDR. Bessac, and XO LCDR Trost is to the right of CDR. Kaufman.



Launching of USS *Scorpion* at Electric Boat Company, Groton, Connecticut,  
19 December 1959

The author, CAPT Mark Golden, USN (Ret), served aboard *Scorpion* in 1961-1962. He currently is a volunteer Blue and Gold Officer for the U.S. Naval Academy Admissions Office and resides in Bloomsburg, PA.



## WHY 2,000 OR EVEN 400 SUBMARINES?

BY NORMAN POLMAR

During the 45 years of the Cold War the Soviet Union operated the world's largest submarine force, reaching a peak of 390 "boats" in 1962. Based on this undersea force, the U.S. Navy had two principal missions: (1) nuclear strike against the Soviet Union and other communist states, and (2) protecting ocean convoys sent to reinforce European allies in time of conflict against the massive Soviet submarine threat.

The U.S. nuclear strike mission initially was performed by the Regulus nuclear-armed missile on submarines and surface ships, and then by carrier-based strike aircraft and ballistic missile submarines. The convoy protection mission led to the construction of more than 130 escort ships (after 1975 called frigates), the anti-submarine modernization of scores of older destroyers, the modification of aircraft carriers for the anti-submarine role, the construction and conversion of submarines for the hunter-killer role, and the procurement of hundreds of specialized land-based and carrier-based aircraft. And, U.S. assistance was provided to several allied navies in building up their anti-submarine forces.

Thus, as Western intelligence detected the Soviet Union producing hundreds of submarines—obviously to fight the "third battle of the Atlantic"—the U.S. Navy and other NATO navies responded with massive investments to protect the ocean convoys that would carry troops, weapons, bombs, bullets, fuel, and other critical material from North America to Europe. Whereas Nazi Germany in 1939 had begun World War II with only 57 U-boats and had threatened to sever the oceanic ties to Britain, the Soviet order of battle—according to U.S. intelligence—could begin a war with hundreds of undersea craft. (When World War II began in 1939 the Soviet Navy had 180 submarines in service.)

Immediately after World War II, U.S. Navy intelligence predicted that by the 1960s it was possible for the Soviets to have 1,200 or even 2,000 submarines of all types at sea. One U.S. admiral made two assumptions in discussing these numbers:

first, an assumption that the Russians will maintain their numbers of submarines in approximately the same amount that they have now



but improve their types and replace older types with new ones, and the second assumption, that by 1960 or within ten years, 1958, that the Russians could have *two thousand up-to-date submarines*. I have chosen that [latter] figure because I believe it is within their industrial capability of producing that number and I believe if they really intend to employ the submarines as a means of preventing the United States or her Allies from operating overseas that two thousand would be the number they would require for their forces. *[emphasis added]*<sup>i</sup>

To reach 2,000 submarines it was estimated that Soviet shipyards would have to produce more than 16 submarines per month; U-boat production in Germany during World War II had reached a maximum average of some 25 submarines per month. A Soviet admiral, also in 1948, reportedly alluded to the possibility of a Red undersea force of 1,200 submarines.<sup>ii</sup>

*But the Soviets never planned to carry out a massive attack on merchant shipping in a so-called Third Battle of the Atlantic.* Discussions with Russian naval officers and submarine specialists have listed several reasons for that decision:

- The German Navy—experts in submarine warfare—was unable to "win" the Battle of the Atlantic in 1914-1918 or 1939-1945; why could the Soviet Navy expect to triumph in a similar campaign?
- At the start of both world wars the Allies were unprepared for a major anti-submarine campaign against Germany; but early in the Cold War the NATO navies began a buildup of anti-submarine forces.
- In World War II the German U-boats had essentially direct access to the North Atlantic from French ports. In a Third Battle the Soviet submarines in the Baltic easily could be "bottled up" by NATO forces, while the Northern Fleet submarines would have to transit around Norway, a NATO ally, and then sail southward while within range of anti-submarine forces based in Norway, Britain, and Iceland.

These "concerns" seemingly escaped Western intelligence. There were some indications of the Soviet reluctance to undertake a major anti-shipping effort; many of these appeared in articles in the professional magazine *Morskoy Sbornik* (Naval Digest), the Soviet/Russian Navy's equivalent of the U.S. Naval Institute *Proceedings*. But that publication

<sup>i</sup> Rear Admiral Charles B. Momsen, USN, statement to the General Board of the Navy, 8 November 1948.

<sup>ii</sup> However, references to such numbers cannot be found in available Soviet documents.



was unclassified, hence material in that journal was "suspect"—often labeled “disinformation” by western intelligence.

Also, during World War II the U.S. intelligence community was totally focused on Germany and Japan. Very few American officers gained any knowledge of the Soviet Navy and related activities.<sup>iii</sup> Accordingly, early in the Cold War the U.S. Navy turned to the surviving officers of the *Kriegsmarine* for assistance, employing these Germans to write about their experiences in fighting the Soviets at sea. One historian who studied the Soviet naval threat of the early Cold War period observed, “This early use of German views by American naval intelligence further entrenched the belief that the Soviet naval threat was a continuation of the German one and that another Battle of the Atlantic—this time replayed with Soviet submarine crews—loomed on the horizon.”<sup>iv</sup>

On a practical basis, the question was asked: Why would the Soviets be building large numbers of submarines: The massive program initiated in the late 1940s produced 48 units in 1954 and 74 in 1955, with improvements in shipyards indicating that a steady rate of 80 or more submarines per year easily could be achieved. Most of these were of a design labeled “Whiskey” by NATO intelligence. While they incorporated many features of the German Type XXI—the most advanced submarine of World War II—the Soviets considered these medium-range craft, for regional seas and defense of the homeland, not for long-range commerce raiding. Still, completing 215 of this class from 1952 to 1958—in addition to other submarines—was a peacetime record for any nation.

The building rate slowed as naval programs were cut back precipitously after the death of Soviet dictator Josef Stalin in March 1953. However, a short time later nuclear-propelled and missile-armed submarines were observed on the building ways; Western intelligence analysts believed that the shift to more advanced undersea craft was the reason for the *temporary* slowdown in production. And, the analysts surmised, the nuclear units would join the diesel-electric (and air-independent propulsion) submarines still being built to threaten the North Atlantic shipping lanes.

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iii One of the few was Rear Admiral Kemp Tolley, USN (Ret.); see his “Caviar and Commissars: The Experience of a U.S. Naval Officer in Stalin’s Russia” (Annapolis, Maryland: Naval Institute Press, 1983).

iv Commander Jessica Huckabey, USNR (Ret.), unpublished conference paper “The U.S. Navy’s Use of German Admirals to Understand the Soviet Naval Threat” (1945-55), McMullen Naval History Symposium, September 2015, page 1.

U.S. naval intelligence specialists began to “question”—not necessarily change—their views in the late 1970s when the United States gained a special source of information on Soviet high-level military planning. One of the very first intelligence community documents to reflect this “new” source of information was a CIA top secret/code word report entitled “The Role of Interdiction at Sea in Soviet Naval Strategy and Operations” (February 1978):

- The Soviet Navy has three principal missions—strategic strike, antisubmarine warfare, and anti-carrier warfare—to which it would allocate the majority of its forces in wartime.
- The Soviet Navy would, in addition, conduct selected attacks on merchant shipping over a wide area of ocean, partly as a means of disrupting Western naval resources. The Soviets would probably allocate a small portion—perhaps 10 percent—of their attack submarine force toward this task.

The report also noted, “the number of merchant ships likely to be sunk over an extended period—four months—indicates that the Soviets have only a limited capability to impair the flow of shipping across the Atlantic, even if they were to reorder their priorities and allocate large forces to interdiction.”

Today Russia is undergoing a metamorphosis with the Navy receiving a major share of defense funding and considerable attention from the national leadership. Are U.S. and other Western intelligence analysts correctly assessing the potential future capabilities and roles of the Russian armed forces and, especially, the Navy? Based on publicly available information, discussions with Russian naval officers and industrial specialists, and other “sources,” it appears that three programs have the highest defense priorities (in alphabetical order):

- Missiles—strategic and tactical
- Submarines (attack, cruise missile, and ballistic missile)
- Tactical aviation

And, there is little indication that today’s Russian submarine force is intended to interrupt Western merchant shipping. Rather, the primary missions—of a comparatively small submarine force—is to (1) maintain and protect a viable SSBN force and (2) to counter Western SSBNs and U.S. aircraft carriers.

In the past Western intelligence was wrong about the primary roles of the Soviet undersea fleet. It also was wrong in assessing many of the characteristics of those submarines—their speed, operating depth, degree of automation, weapons, hull materials, etc. Even estimates of the Soviet *rate of progress* in submarine quieting—an area in which the U.S. submarines unquestionably held the lead—generally were wrong.

Why these past failures? And, could such shortcomings in analysis be avoided in the future? *First* it is important to understand the “why” of these past intelligence failures. The following reasons are offered:

- We fail to consider all sources—classified/black *and* unclassified/open.
- We look for what we know and for what we want to believe.
- We tend to mirror image... thus we do not accept new concepts if they do not fit our mindset and experience—that experience included two desperate Battles of the Atlantic.
- Excellent Soviet/Russian intelligence that gleaned secrets from Western classified and open sources as well as from classified sources... we are an open society.
- Poor U.S. counterintelligence that too often failed to identify agents within Western defense and intelligence communities.

The following are offered as possible solutions to this situation:

- Read history and contemporary writings—*especially theirs*.
- Look for “real” threats—not just what’s easy to see...look at the forest while studying the trees.
- Look for the anomalies—even the small ones...avoid a “climate of conformity.”
- Share “ideas”—not just intelligence—with friends and allies, in the “business” and in associated positions.
- Avoid looking for a panacea—most reorganizations and name changes in the intelligence field are political as are most slogans, e.g., “information dominance.”
- And, “*think outside of the box.*”

The last is very important. While many people often use that slogan, very few people do “think outside of the box.” Indeed, very few people can provide examples of that concept. Here are a few valid examples of this “technique.”

• One that directly relates to submarine warfare was Soviet submarine designer Sergei Kovalev and the Typhoon ballistic missile submarine (SSBN) that went to sea in late 1981.<sup>v</sup> All previous SSBNs had their missile tubes in the after portion of an elongated sail or in the hull aft of the sail. Kovalev and his team considered numerous design variations including “conventional” designs, i.e., a single elongated pressure hull with the missile tubes placed in two rows aft of the sail; this last approach was discarded because it would have produced a submarine more than 770 feet long, far too great a length for available dry docks and other facilities. Instead, Kovalev and his team developed a unique and highly innovative design—the 441st variant that they considered. The ship has two, parallel main pressure hulls to house crew, equipment, and propulsion machinery; these are full-size hulls, each with eight compartments. The 20 large missile tubes are placed between these hulls, in two rows, *forward* of the sail. Thus, the Typhoon presented a unique configuration—and the largest undersea craft ever built.

• Admiral “Sandy” Woodward in the Arabian Sea exercise in 1982<sup>vi</sup>: In early 1982—shortly before the Falklands war erupted—then-Rear Admiral Woodward commanded a destroyer, three frigates, and three replenishment ships. His group was opposed by the U.S. aircraft carrier *Coral Sea* (CV-43), embarking some 80 aircraft, with accompanying cruisers and destroyers.

The British ships were some 200 miles from the U.S. carrier. As the exercise started a U.S. Navy fighter just happened to appear over Woodward’s ships and identified them. Still, during the night—despite challenges from other U.S. aircraft and a surface warship—Woodward in the destroyer *Glamorgan* was able to close the 200-mile gap and, early the following morning simulated launching the ship’s four Exocet missiles at the *Coral Sea* (from a range of about 20 miles).

Woodward’s “bottom line”: “Therefore, reads the moral of this tale, take caution should you ever find yourself as a battle group commander in these circumstances, because it is fairly likely that in *bad* weather, you would lose the battle. This is especially true against a really determined

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v See Norman Polmar and Kenneth J. Moore, “Cold War Submarines” (Dulles, Virginia: Brassey’s, 2004), pages 194-195.

vi Admiral Sandy Woodward, RN, “One Hundred Days: The Memoirs of the Falklands Battle Group Commander” (Annapolis, Maryland: U.S. Naval Institute Press, 1992), pages 63-65. Woodward subsequently commanded British forces in the 1982 retaking of the Falkland Islands.



attack in which the enemy is prepared to lose several ships in order to sink your carrier....”<sup>vii</sup>

• Reducing the bounties on Al Qaeda leaders<sup>viii</sup>: During the American campaign against Al Qaeda terrorists in Afghanistan, the U.S. government offered “hefty” bounties for Al Qaeda, Taliban, and other insurgent leaders. These bounties were highly publicized.—and rarely collected because of the deadly retribution against anyone who pointed out terrorist leaders to American forces.

Experts at the U.S. Central Command decided to “toy” with the terrorist commanders: Military and intelligence analysts drew up a list of high-value targets. Then there was a public announcement that the bounty on a particular terrorist leader had been slashed. Word was whispered in the local markets that the man wasn’t worth the higher reward because he had been injured or has been deemed incompetent.

According to Eric Schmitt and Thom Shanker of *The New York Times*, the “less-valuable leader” now “wants to prove he is still important and worthy of the higher bounty. Even senior members of Al Qaeda’s global network have been suckered by the ruse and have been picked up after they made themselves visible not long after the bounty on their heads was reduced.”<sup>ix</sup>

The terrorist leaders had called attention to themselves by announcing new plans to attack the enemy, often using their cell phones.

If U.S. military forces are to be effective in the future—against an exceedingly broad range of threats in both crises and conflict, they require first-rate intelligence. The men and women who collect, analyze, and provide that intelligence must be more efficient than those dedicated personnel who, in the Cold War, got it wrong with respect to the concept of the Soviet Navy fighting a Third Battle of the Atlantic.

The men and women of today’s intelligence community in many respects are better educated and have better tools than had their predecessors. They must, however, learn the lessons from the Cold War and they must learn to “think outside of the box.” Some of our opponents certainly will.

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vii Ibid., page 66.

viii Eric Schmitt and Thom Shanker, “Counterstrike: The Untold Story of America’s Secret Campaign Against Al Qaeda” (New York: Times Books/Henry Holt, 2011), page 189.

ix Ibid.

## COMSUBDEVGROUP TWO / COMSUBDEVRON TWELVE 1949 – 2016

BY WILLIAM J. BROWNING

COMSUBDEVRON TWELVE held a Change of Command and Sundown Ceremony at the Submarine Force Library and Museum, Groton, Connecticut, 15 January 2016. OPNAV Notice 5400, 29 February 2017, renamed Commander, Submarine Development Squadron TWELVE as Commander, Submarine Squadron TWELVE ending a remarkable 67 year experiment in Submarine Force tactical development.

CAPT Frank Andrews, USN (ret), COMSUBDEVGRU TWO, 1962–1964, in the lead article in the first issue of *The Submarine Review* in 1983, wrote “One of the brightest ideas the Submarine Force has ever had was the formation of a permanent special-mission team which employed operating submarines and was called the Submarine Development Group.” (Reference [a]).

**History.** Submarine Development Group TWO was formed in 1949 to “solve the problem of using submarines to detect and destroy enemy submarines.”

The origin and early days of SUBDEVGRU TWO are described in RADM Roy Benson’s oral history (Reference [b]). CAPT Andrews, (Reference [a]) in discussing the history and contributions of the DEVGRU from 1949 to 1982, divides that history into three eras: I. Start-up and Exploitation of Battery Boats; II. TAG, Full Arrival of Nuclear Boats, Towed Array and Mk 48; and III. NWP 70 series, Transition to SSN 688, Reemphasis of Naval Squadron Responsibilities.

RADM Robert R. Fountain, USN (ret), COMSUBDEVRON TWELVE, 1976–1978, at the 50th Anniversary Symposium; chaired by ADM Bruce DeMars, USN (ret), COMSUBDEVRON TWELVE, 1978–1979; held at Subase New London in May 1999; described the fifty year history and accomplishments of the Command and identified challenges facing the Command going forward (Reference [c]).

The Squadron Commanders during the Command’s 67 year history are listed in Figure 1. The Submarine Force assigned their “best and brightest” to lead this unique command. The Commanders in the 1950s



were all distinguished World War II submarine captains including Roy Benson, USS *Trigger*; Barney Sieglaff, “Operation Barney”; and Earl Hydeman, “Hydeman’s Hell Cats”. All the 1950s Commodores were Navy Cross awardees, several with multiple Navy Crosses (Gallaher, 4 Navy Crosses; Sieglaff, 2 Navy Crosses; Walker, 2 Navy Crosses). As the Submarine Force transitioned to an all nuclear force, the World War II captains were followed by captains experienced in Cold War special operations. Almost all subsequently achieved flag rank; six with four stars (DeMars, Mies, Giambastiani, Donald, Caldwell, Richardson) and six with three stars (Jones, Metzger, Munns, Van Buskirk, Burke, Merz).

**Tactical Analysis Group (TAG).** In 1963, CAPT Frank Andrews established a Tactical Analysis Group consisting of Naval officers trained in operations analysis and civilian analysts. Embedding analysts in an operational squadron was unique in naval tactical development at the time and would remain so for the next 50+ years.

This wasn’t a new idea in the Submarine Force.

VADM Charles A. Lockwood, USN, COMSUBPAC, 1943–1946, in *Sink 'Em All: Submarine Warfare in the Pacific* (Reference [d]) describes the SORG at COMSUBPAC during World War II:

*“Back in the fall of 1943 we had added a small section to our Headquarters Staff. The new outfit, headed by Dr. K.F. Rinehart, was named SORG (Submarine Operational Research Group). This addition represented a distinct departure from traditional naval organizational set-ups. Its mission was to study and analyze patrol reports and other forms of intelligence, to determine whether or not our operational methods were the most effective which could be employed, what enemy antisubmarine measures were most dangerous to our boats, what evasive tactics on our part led to best results, and so on. In short, Dr. Rinehart and his assistants were an unbiased, uninhibited, scientific group of kibitzers, who reduced everything we did to figures or graphs and showed us in black and white what was happening. They were in constant contact with AS-WORG (Anti-Submarine Warfare Operational Research Group) in Admiral King’s Tenth Fleet in Washington, from whom they got valuable tips based on the Battle of the Atlantic. The results they produced were startling at times and always highly valuable in shaping the trend of our efforts. Before the war ended they could tell us— and prove their state-*



*ments—what firing ranges produced best results, what type of torpedo spread got the most hits, what agencies probably caused our heaviest losses—there seemed to be nothing which they could not reduce to a punch card on an IBM machine. The results of their studies were published monthly or oftener, in our Submarine Bulletin.”*

The contributions of the DEVGRU/DEVRON TAG to submarine tactical development and evaluation over the years were extensive. Primary areas were

- Submarine tactical exercises. Planning, conduct, reconstruction and analysis. These exercises helped provide estimates of Weapon Systems Effectiveness. Exercises included the “Big Daddy” series of ASW exercises in the 1960s; the RANGEX series of passive ranging exercises; the SUBASWEX series of ASW exercises; the SECEX series of security exercises; the SSN 688 Tactical Development Program; and the TACDEVEX series;
- Analysis of real-world operations;
- Naval Warfare Publications Series 70 and NTP/NTRP 3-21 series;
- Submarine Fleet Mission Program Library, ARCI and APB—tactical decision aids.

Almost all the TAG civilian analysts were ex-submariners. However, for 40 years, the TAG included a few young Ph.D. mathematicians without prior experience with the Navy. This small group made significant contributions in a number of areas: Submarine Search Manual, Passive Ranging Manual, Acoustic Data Manual, TMA Reference Manual, US/UK Tactical Development project, SFMPL TACAIDS, towed array TMA, and time-corrected Ekelund ranging.

Data is oxygen for ops analysis. Ironically as data has become much easier to archive electronically on the boats (as opposed to manual logs in the 1960s–1980s), analyst access to those electronic records has become much harder (“Why do you want it? Tell me what you are going to do with it?”)

Being embedded in an operational squadron like COMSUBDEVRON TWELVE allowed the analysts easy informal access to the squadron boats, their crew, and their data which helped immensely in identifying and quickly resolving problems.

Montgomery C. Meigs (Ph.D. historian and U.S. Army General), in his study of scientists and subsurface warfare in World War II, [Slide Rules and Submarines](#) (Reference [e]) observes

*“The intimate relationship between knowledgeable scientists and naval officers immersed in operations made for the closest possible link between the operational problem and the potential technological solution. This intimacy depended on the removal of service bureaucracies normally charged with development and procurement.”*

Meigs concludes that

*“American scientists contributed to American victories in subsurface warfare in World War II in two ways. They forged better weapons of war. But most important, they measured and analyzed, in a way far more unbiased than their counterparts in uniform, what was happening in combat at sea and what had to be done to win. To the credit of the Navy, younger men like Captain Wilder D. Baker, Vice Admiral F.S. Low, and Vice Admiral Charles A. Lockwood saw the merit of ideas of scientists. With the support of pragmatic senior leaders like Admiral Richard S. Edwards, Admiral Chester Nimitz, and Admiral Royal Ingersoll, they were able to make these ideas an indispensable component of victory at sea.”*

**Conclusion.** Admiral John M. Richardson, USN, Chief of Naval Operations (COMSUBDEVRON TWELVE, 2005–2006) in *A Design for Maintaining Maritime Superiority* (Reference [f]), challenges the Navy to “Optimize the Navy intellectual enterprise to maximize combat effectiveness and efficiency. Reinvigorate an assessment culture and processes.” and to “Understand the lessons of history so as not to re-learn them.”

In the years between wars, military organizations can lose focus and become so sclerotic that they must be disestablished.

But for many years, embedding scientists with Naval officers in an operational squadron provided the Submarine Force an “assessment culture” for developing tactics and assessing its weapon systems. This bright idea has served the Submarine Force well in the past, supports the lines of effort in *A Design for Maintaining Maritime Superiority*, and would serve the Submarine Force well again in the future.

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## Browning continued --

Figure 1. Squadron Commanders, 1949 - 2016

<b>CAPT R.S. BENSON, USN</b> May 1949 - Aug 1950	<b>CAPT V.L. HILL, JR, USN</b> Jul 1983 - Jun 1985
<b>CAPT W.B. SIEGLAFF, USN</b> Aug 1950 - Jun 1951	<b>CAPT T.D. RYAN, USN</b> Jun 1985 - Jun 1987
<b>CAPT E.T. HYDEMAN, USN</b> Jun 1951 - Jul 1953	<b>CAPT D.A. JONES, USN</b> Jun 1987 - Mar 1989
<b>CAPT A.R. GALLAHER, USN</b> Jul 1953 - Aug 1955	<b>CAPT R.W. MIES, USN</b> Mar 1989 - Jun 1990
<b>CAPT F.D. WALKER, USN</b> Aug 1955 - Jul 1957	<b>CAPT F.W. LaCROIX, USN</b> Jun 1990 - Jun 1991
<b>CAPT R.B. LYNCH, USN</b> Jul 1957 - Jun 1958	<b>CAPT E.P. GIAMBASTIANI, USN</b> Jun 1991 - Jun 1993
<b>CAPT R.F. DUBOIS, USN</b> Jul 1958 - Jul 1960	<b>CAPT J.W. METZGER, USN</b> Jun 1993 - Jul 1994
<b>CAPT C.J. ZURCHER, USN</b> Jul 1960 - Jul 1962	<b>CAPT C.L. MUNNS, USN</b> Jul 1994 - Aug 1995
<b>CAPT F.A. ANDREWS, USN</b> Jul 1962 - May 1964	<b>CAPT K.H. DONALD, USN</b> Aug 1995 - Jul 1997
<b>CAPT M.U. MOORE, USN</b> May 1964 - Jul 1967	<b>CAPT D.A. GOVE, USN</b> Jul 1997 - Jul 1999
<b>CAPT W.M. PUGH, II, USN</b> Jul 1967 - Oct 1968	<b>CAPT J.A. WALSH, USN</b> Jul 1999 - Mar 2001
<b>CAPT G.T. SMITH, USN</b> Oct 1968 - Nov 1968	<b>CAPT S.R. VAN BUSKIRK, USN</b> Mar 2001 - Feb 2003
<b>CAPT C.E. WOODS, USN</b> Nov 1968 - Sep 1970	<b>CAPT J.F. CALDWELL, JR, USN</b> Feb 2003 - Mar 2005
<b>CAPT J.F. FAGAN, JR, USN</b> Sep 1970 - Sep 1972	<b>CAPT J.M. RICHARDSON, USN</b> Mar 2005 - Aug 2006
<b>CAPT G.H.B. SHAFFER, USN</b> Sep 1972 - May 1974	<b>CAPT K.M. PERRY, USN</b> Aug 2006 - Jul 2008
<b>CAPT R.C. AUSTIN, USN</b> May 1974 - Jul 1976	<b>CAPT R.P. BURKE, USN</b> Jul 2008 - Sep 2010
<b>CAPT R.R. FOUNTAIN, JR, USN</b> Jul 1976 - Jun 1978	<b>CAPT W.R. MERZ, USN</b> Sep 2010 - May 2012
<b>CAPT B. DeMARS, USN</b> Jun 1978 - May 1979	<b>CAPT V.J. PARKS, JR, USN</b> May 2012 - Jun 2014
<b>CAPT S.L. WARD, III, USN</b> May 1979 - Oct 1981	<b>CAPT L.C. DOLLAGA, USN</b> Jun 2014 - Jan 2016
<b>CAPT D.R. SACKETT, JR, USN</b> Oct 1981 - Jul 1983	

## HUNTERS AND KILLERS

BY NORMAN POLMAR AND EDWARD WHITMAN  
ANNAPOLIS MD, *NAVAL INSTITUTE PRESS*, 2016

*REVIEWED BY RADM T.A. BROOKS, U.S. NAVY (RET.)*

Author and naval historian Norman Polmar and Engineer/Scientist (and former editor of *Undersea Warfare* magazine) Edward Whitman have collaborated in writing what is advertised as “...the first comprehensive history of all aspects of anti-submarine warfare (ASW) from its beginnings in the 18th Century...”. But the two volume set *Hunters and Killers* is more than that.

ASW can only be understood in the context of the submarine operations it is attempting to counter. Thus, the capability of the submarine and the way in which it is operated impacts ASW as much as – and often more than—the weapons, sensors, and tactics that anti-submarine forces employ. Recognizing this fact, *Hunters and Killers* dedicates as many pages to describing submarine campaigns as it does to analyzing ASW efforts against these campaigns. For example, some 45 pages are dedicated to describing the World War I German U-boat campaign and over one hundred pages to describe in great detail the World War II Battle of the Atlantic. The coverage of these campaigns and the analysis of the success (or lack thereof) of the submarine forces and the ASW efforts against them yield valuable, and often fascinating insights into what worked and what didn’t, with many of these insights just as applicable today as they were 75 or 100 years ago.

*Hunters and Killers* is published in a large format (8 ½X 11 inches) with many excellent photographs, charts and illustrations. Volume I covers the period 1776 (attempted attack on HMS *Eagle* by the submersible *Turtle*) to May, 1943, when Admiral Doenitz ordered his wolfpacks to withdraw from the North Atlantic convoy routes because the massive Allied investment in ASW had finally turned the tide against the German U-boat. Volume 2 considers the remainder of World War II, covers the Cold War ASW buildup, and takes ASW up to the present day, with projections of submarine warfare/ ASW issues of the future.



The popular press often characterizes ASW as a game of cat-and-mouse, with ASW forces being the cat and submarines being the mouse. *Hunters and Killers* demonstrates how, over time, the tactical advantage has swung back and forth between cat and mouse. Surely in the beginnings of the two world wars, the advantage was decidedly with the submarine mouse but by the end of World War II, the ASW cat had forged ahead. After World War II, assets dedicated to ASW declined and submarine technology forged ahead, culminating in the nuclear submarine and quiet, long-endurance conventional submarines, some with air-independent propulsion. Despite significant investments in ASW sensor systems and weapons, it was unclear whether the cat of the mouse was in the ascendancy. But with the continued quieting of Soviet/ Russian nuclear submarines and the huge reduction in ASW investment (sensors, platforms and, importantly, training) as the Cold War ended, it would appear that the mouse now has a significant advantage.

Those who believe this to be the case should read Chapters 8 through 13 of Volume 2 and ponder what happens to the cat-mouse equation if non-acoustic sensors are developed which allow for detection of the quietest of submarines—"ours" and "theirs." The Soviets/Russians have been conducting significant research in this area and have fielded suites of detection systems which, while individually far inferior to U.S. acoustic detection systems of the past, when netted together appear to have much more detection capability than we ever credited them with.

*Hunters and Killers* is an obvious "must read" for those who are interested in ASW—particularly the decay of ASW capability in the U.S. Navy. But of equal importance, those who design, equip, and operate submarines should, in particular, read Volume 2 and ponder the impact on the U.S. submarine force if the cat does, in fact, have some non-acoustic ASW tricks up its sleeve.

*Rear Admiral Brooks served as the Director of Naval Intelligence 1988-1991.*

**USS *ALBACORE* (AGSS569)  
AN ORAL HISTORY**

**EDITED BY JACK HUNTER AND AUSTIN JORDAN  
CREATESPACE INDEPENDENT PUBLISHING PLATFORM,  
NORTH CHARLESTON, S.C., 2017**

***REVIEWED BY CAPT JOHN F. O'CONNELL, USN, RET.***

When WW II ended the Allies discovered that they were badly lagging Germany in submarine design. The German Type XXI boat, with streamlining and high capacity batteries, had significantly higher submerged speed and endurance. Although no Type XXI boat saw action, several of its clones – the smaller Type XXIII operated off the UK from Norwegian bases and sank a number of ships without loss to its own ranks.<sup>i</sup>

The U.S. set about to improve its submarine capability. Measures included the Guppy program to use existing fleet boat hulls in a series of streamlining conversions, the installation of snorkels, and the design of a new diesel-electric class based upon the Type XXI boat – the Tang class. In parallel the Bureau of Ships resumed its prewar contemplation of nuclear energy as a submarine power source, one that promised almost unlimited endurance if it could be successfully engineered.

Two new design submarines emerged from this arena – the *Albacore*, a submarine designed as a body of revolution to achieve very high speeds submerged; and *Nautilus*, basically a Tang-class hull with a revolutionary nuclear propulsion plant. This book describes *Albacore* through a series of oral interviews with crew members who served in her.

*Nautilus* was highly successful and led to the Skate-class SSN, still with a Tang-class hull. *Albacore* was also highly successful. Her advanced hull form was incorporated into the Barbel-class SS, Skipjack-class SSN, and basically every nuclear attack submarine built thereafter.

The book is structured around the four major configuration phases of *Albacore*'s life from 1953 to 1972. Within each phase, various crew members from Captain to Chief of the Boat to cook, relate their personal

<sup>i</sup> One Type XXI made a patrol but conducted no attacks.



recollections and observations of *Albacore* operations and life aboard.

The furthest *Albacore* ever deployed was to the Key West area and Tongue of the Ocean. Otherwise she was either in Portsmouth Naval Shipyard undergoing conversion or repair, or on local operations in the Gulf of Maine.

*Albacore* was as pure a research submarine as it was possible to design. She was diesel-electric, albeit equipped unfortunately with the infamous German-designed pancake diesel engines that might have represented their desire to enact a degree of revenge for losing the war.<sup>ii</sup> She had no snorkel, nor torpedo tubes. Her tasks were to explore high submerged speeds and associated control problems. Innovations included one-man control submerged by a ‘pilot’ instead of a diving officer, two planesmen and a helmsman; a dorsal rudder; trim tabs; dive brakes on the hull in one configuration; an X-configuration stern; and the installation of a former B-47 aircraft retarding parachute as a safety device in the top aft section of her sail to enable *Albacore* to recover from steep down angles. *Albacore* also led the way in the use of HY-80 steel in U.S. submarine construction.

During Phase III operations she reached a submerged speed of 32 knots.<sup>iii</sup> Later, with the Silver-Zinc battery and counter-rotating propellers she exceeded that speed, reportedly reaching somewhere between 36 and 40 knots.<sup>iv</sup>

Two of her commanding officers, Jon Boyes and Lando Zech, went on to make flag rank, both retiring as Vice Admirals. Lando Zech also commanded *Nautilus*. Since 1985 *Albacore* has been on display as a museum submarine in Portsmouth, New Hampshire.

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ii The Tang-class was similarly equipped. They were later re-engined and their pancake engines and spare parts were consolidated at Portsmouth Naval Shipyard where they enabled *Albacore*'s engineers to keep her engines operating despite many casualties.

iii CO Jim Organ comments, p. 315.

iv Email discussions with Jack Hunter, a Phase IV officer, based upon his recollections of conversations with control room watch standers at that time.



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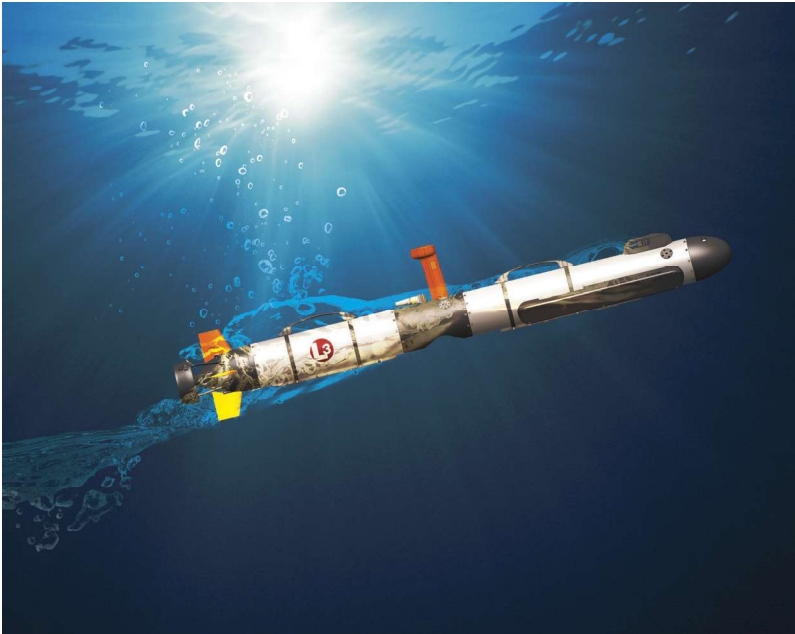
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