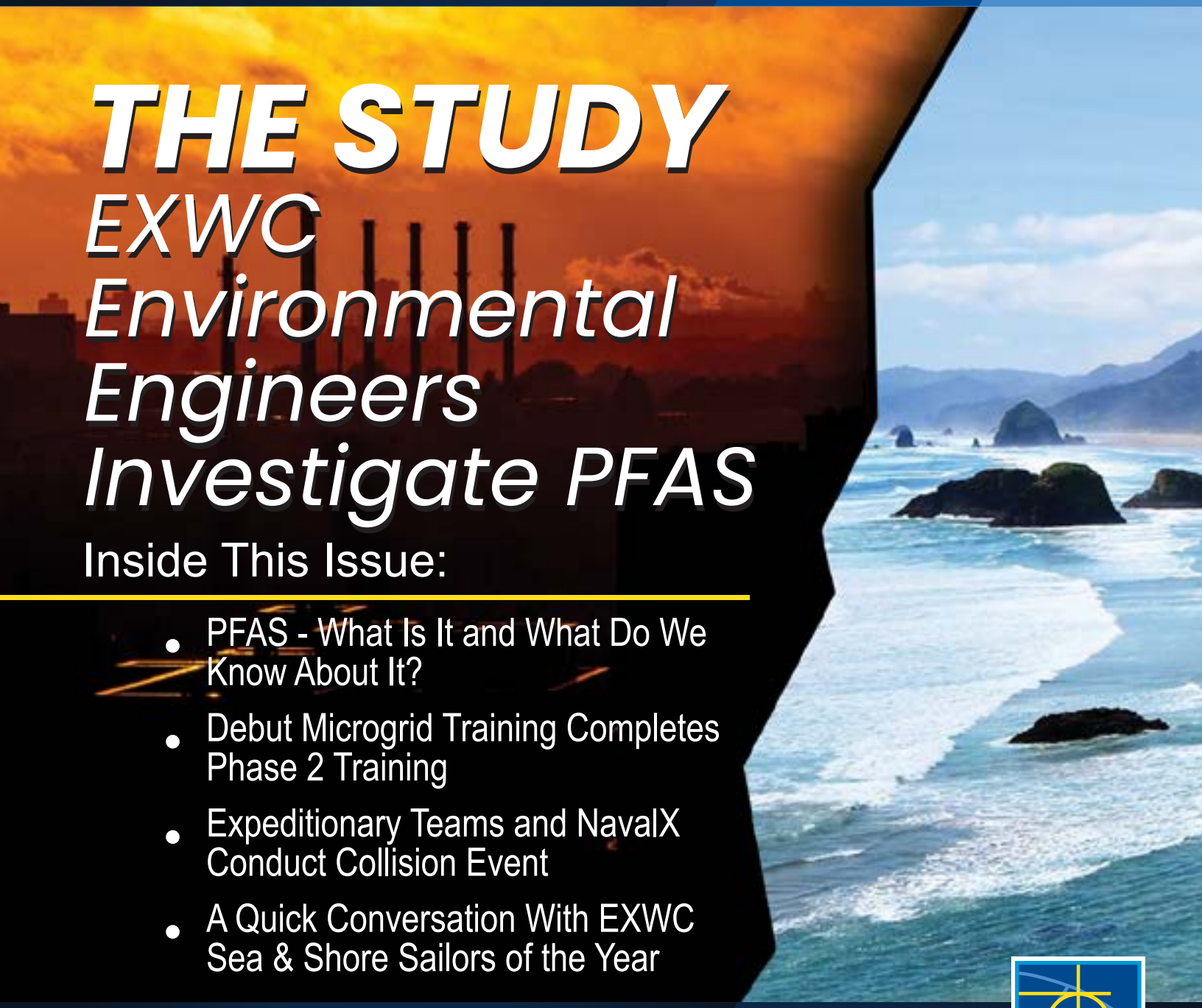
EXWC
EDGE
eMagazine

THE STUDY

EXWC Environmental Engineers Investigate PFAS

Inside This Issue:



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ANTICIPATE – INNOVATE – ACCELERATE

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A Message From Jennie Dummer, Environmental Security Department Head

Greetings Team EXWC,

It is my pleasure to write the introduction for this month's EXWC EDGE, featuring work from our environmental security department. In this issue, we are pleased to highlight the fascinating and important study of per-and polyfluoroalkyl substances—otherwise known as PFAS (and much easier to pronounce).

As the department head for environmental security, I have the unique and priviledged responsibility of working with some of the most talented engineers and scientists, each dedicated to the Navy's environmental vision and mission.

In all previous command iterations, and presently today, NAVFAC EXWC has always strived to solve different environmental 'big problems'. Our engineers and scientists see everything as a system, and they study and design under enormous constraints. They see elements, structures, and possible solutions that are not always instantly apparent. The enclosed articles on PFAS provide a glimpse into their methods of study and an appreciation for the work they accomplish daily here at NAVFAC EXWC and accross the enterprise, for the warfighter.

I encourage you to read the enclosed articles on PFAS, written in a style of technical journaling. These articles are informative, and chopped into bite size blocks that permit the casual reader to comprehend how we approach solving complex problems. In the case of PFAS, in our quest to develop solutions, we study the issue—the very make-up of the chemical PFAS. In doing so, our studies allow us to present our findings and collaborate with other industry leaders to find solutions together.

In addition to PFAS, this month's EXWC EDGE displays several other projects, programs, and command recognition here at NAVFAC EXWC. Before I sign off, I would like to extend my personal thanks to the entire environmental team for your dedication and unwavering commitment to NAVFAC EXWC during this last year of incredibly challenging hurdles.

On behalf of environmental security, and our global NAVFAC EXWC team, enjoy your EXWC EDGE.

Very Respectfully,

Jennie Dummer, P.E.
Environmental Security Department Head

PFAS-

What Is It and What Do We Know About It?

PFAS Characterization

Photo credit: Airman 1st Class Lauren Hunter

Written by: John Kornuc, Ph.D., NAVFAC EXWC Physical Scientist

What is PFAS? An Introduction to the Attention-Grabbing Chemical Headlines

You may have heard about the group of chemicals called PFAS, the acronym for ***per- and polyfluoroalkyl*** substances, as they have probably received the greatest level of attention of any chemicals in recent history. There has even been a major motion picture release (Dark Waters, 2019), a legal drama centered on PFAS release into the environment. One of the reasons for the popularity, or rather notoriety, of PFAS is that they are a large group of chemical compounds included in a vast array of everyday consumer products such as paper goods, clothing, carpeting, and cosmetics, as well as industrial products like firefighting foam. In short, they are practically everywhere. In addition, because PFAS are in so many products and used in manufacturing processes, they have made their way into the environment through a variety of release mechanisms. Moreover, once in the environment, many PFAS are highly mobile and persistent. Their persistence is a result of their resistance to degradation by heat, chemicals, and photodegradation, some of the same characteristics that make them so useful for their intended uses. In addition to their persistence and mobility, some PFAS have also been found to be bioaccumulative in plants, animals and people.

This article will touch on a variety of topics concerning PFAS, including their behavior in the environment as a function of their structural chemistry, as well as remediation methods. Hopefully it will serve as an introduction to some and provide some food for thought for others more familiar with them.

PFAS Belong to the Large Group of Chemicals Known as Organoflourines

PFAS are synthetic chemicals belonging to a broad class of chemicals called organofluorines, which are compounds characterized by the carbon-fluorine bond. The carbon-fluorine bond is one of the strongest bonds in organic chemistry, and this bond strength is responsible, in large part, for the stability of these compounds. You are probably most familiar with the organofluorines which belong to the class known as ***fluoropolymers*** (the non-stick material used on many household pots and pans). While the building blocks of fluoropolymers are structurally similar to PFAS, fluoropolymers are less an environmental concern, being relatively immobile very large polymeric molecules which are not water soluble. You are probably also familiar with the organofluorines used as refrigerants for air conditioning and other climate control systems, that besides containing the carbon-fluorine bond, also contains some carbon-chlorine bonds and as a class are called ***chlorofluorocarbons***—volatile liquids or gaseous compounds which are harmful to the ozone layer. Their replacements—the ***hydrofluorocarbons***—are much less harmful to the ozone layer and are a related organofluorine class.

The simplest organofluorines are compounds that contain only carbon and fluorine—the ***fluorocarbons***. Fluorocarbons that contain other elements such as nitrogen and iodine, or organic groups such as amines, carboxylates, and sulfonates, are the perfluorinated compounds which are included a subset of PFAS, that is the subject of this article. As if all of that wasn't complicated enough, there are upwards of several thousand PFAS compounds (some estimates range up to 10,000 compounds), but two of these, PFOS and PFOA (***perfluorooctane sulfonate*** and ***perfluorooctanoic acid)***, are the most well known and studied. It is easy to confuse PFOS with PFAS, but PFOS is one PFAS compound—PFAS refers to the thousands of structurally similar, but distinct, compounds. Both PFOS and PFOA were the first PFAS to be commonly found in the environment. The concerns for these compounds is that they may lead to adverse human health and environmental effects.The toxicity of most PFAS have yet to be studied, though substantial progress has been made on PFOS and PFOA, as well as several other PFAS most commonly found in the environment, including those sites impacted by firefighting foam.

Helicopters, boats and Sailors battle raging fire aboard USS Bonhomme Richard in San Diego, Calif. (Courtesy U.S. Navy photo)

Unlike many other chemicals, PFAS have a broad range of uses and are therefore detected in the environment with much greater frequency than many other chemicals of concern. Besides their persistence and mobility, the detection levels for PFAS are very low, currently in the 'parts per trillion' range. For most other chemicals—such as ***benzene*** and ***petroleum hydrocarbons***—analytical detection levels are typically in the 'parts per million or parts per billion' range. PFAS detection levels in the parts per trillion are 1,000x more sensitive than parts per billion. Therefore, it is not surprising that PFAS are detected with a greater frequency in environmental samples than other chemicals of concern, since their detection levels are so low and their (low level) presence is widespread. Because the detection levels are so low, great care must be taken during sampling and analysis to prevent contamination of samples with sampling equipment and containers. Small contributions from other materials can result in large biases in results where low concentrations of PFAS are most often detected.

PFAS-

What Is It and What Do We Know About It?

PFAS Characterization Continued...

PFAS and the Navy's Concerns

One of the primary concerns for the Navy and the Department of Defense (DOD) with respect to PFAS centers around the firefighting foam known as ***aqueous film-forming foam***—or AFFF—used to extinguish liquid petroleum fires. Several potential sources of PFAS exist due to many products and processes that use them, but AFFF is somewhat unique in that their PFAS concentrations are inherently high, relative to most other sources such as consumer goods, including packaging, textiles, waterproofing formulations, and personal care products.

PFAS comprise over 6,000 individual compounds with widely varying physical, chemical, and toxicological properties. The main concern for the DOD and the Navy has been PFAS in AFFF, which comprise a much smaller subset of compounds numbering in the hundreds.

AFFF containing PFAS has been used by the DOD since the early 1970s, and each manufacturer's formulation contains a proprietary list of PFAS compounds, which also changed over time. While the early environmental samples were being analyzed by standard methods for the two PFAS of initial concern—PFOS and PFOA—academic research laboratories developed advanced analytical methods to "reverse engineer" the PFAS content of various AFFF formulations. Over time, PFAS were added to the standard methods analyte list, based partly on these findings and advancements in analytical methodologies, as well as expanded availability of PFAS analytical standards.

To accurately determine the amount of a particular chemical present in a sample requires that a known amount of a standard is run on the analytical instrument. For PFAS, only a relatively small number of analytical standards are available compared to the much larger number of PFAS compounds known to exist, or even compared to the smaller subset of PFAS compounds known to be present in AFFF formulations. The analytical standard limitation inherently limits the number of PFAS that a standard laboratory method can analyze, though the number of compounds has steadily increased and continues to increase over time.

Research laboratories also analyzed environmental samples from firefighter training areas (FTAs) to better understand which AFFF formulations were historically used at DOD sites. In most cases, it was apparent that multiple AFFF formulations were used at FTAs, since PFAS from more than one formulation was almost always detected. In addition, transformation of some PFAS was noted. PFAS—which can transform into other PFAS under environmental conditions—are often referred to as precursors. These include many of the polyfluoroalkyl substances, which have part of their carbon backbone unsubstituted by fluorine and therefore have a "weak point" where fluorine is not present to "protect" the carbon backbone where chemical or biological transformation can take place. Precursors often transform to more stable PFAS such as ***perfluoroalkyl acids*** (PFAA), which include PFOS and PFOA. This transformative potential of precursors may be an important consideration in fate and transport at PFAS sites.

The Site Characterization Process for PFAS

In many respects, the site characterization process for PFAS is the same as that for other chemicals of concern. The first step is to assess whether PFAS are potentially present at a site based primarily on the review of existing information related to the use of PFAS-containing material or processes at the site. This could include use, storage or disposal of PFAS materials. AFFF use or stowed is an obvious potential source, but other materials or operations may also have resulted in a release of PFAS, such as oil/water separators near hangars and disposal of biosolids from wastewater treatment plants where AFFF residuals may have been treated. This step is typically known as the preliminary assessment, or PA, and may include inspection of historical records to determine past uses of the site, interviews with workers familiar with the site, and previous site sampling and remediation. In conducting the PA, one must carefully consider various types of potential sources. While FTAs are among the more obvious potential sources, consideration should also be given to operations that are less obvious. For example, a car wash facility may have soap containing PFAS. The PA establishes if further action, such as a site inspection, is warranted or if the site should be designated as requiring no further action. The PA helps to formulate the preliminary Conceptual Site Model (CSM), though many sites where PFAS may be a concern may already have had a CSM developed for other chemicals of concern—which can be used or provide supplemental information for development of the preliminary CSM.


Courtesy EPA photo

An important distinction for PFAS which deviates from the typical PA process is that Navy policy established that if a drinking water source—on- or off-site—is located within 1 mile downgradient of a known or potential PFAS source on Navy property, then the drinking water must be sampled and analyzed for PFAS. If either PFAS levels, or their sum, are above the EPA Lifetime Health Advisory of 70 ng/L (70 parts per trillion) in the drinking water, that mitigation be carried out (such as supply of bottled water, installation of a point-of-use treatment system, or connection to an alternate water supply).

Once the PA is complete and it has been established that PFAS was or may have been released at a site, the next step is limited sampling. This is the site inspection stage, or SI. The SI samples various media to document the presence of chemicals of concern, but usually does not fully delineate their extent. The SI follows the Navy's systematic planning requirements including the preparation of an approved sampling and analysis plan, in accordance with the Uniform Federal Policy for Quality Assurance Project Plans. The sampling plan for PFAS follows the same general considerations for other chemicals of concern, and relies on information collected during the PA and incorporated into the CSM, such as:

1. ***Use and handling of PFAS-containing material and potential release mechanisms***
2. ***Physical site characteristics including soils, geochemistry, hydrology, etc.***
3. ***Other contaminants and prior investigations***
4. ***Prior remediation of other contaminants***
5. ***Fate and transport properties of the chemicals of concern, and***
6. ***Potential receptor pathways***

PFAS-

What Is It and What Do We Know About It?

PFAS Characterization Continued...

Courtesy U.S. Navy photo

As is the same for other chemicals, the CSM guides the sampling approach. Once the SI is complete (the SI may also be carried out in multiple phases) the site may move on to the remedial investigation (RI) stage where further characterization takes place if the SI results move the site in that direction—if, for example, the conservative risk screening values are exceeded. Nevertheless, the general consideration for the SI still apply to the RI phase.

In addition to the general considerations of SIs for other chemicals, PFAS do have some specific issues to be considered, including:

1. ***PFAS often behave very differently than other chemicals due to their unique structure, having both polar (hydrophilic) and non-polar (hydrophobic) character***
2. ***PFAS are a large group of chemicals with varying chemical and physical properties, and therefore, varying fate and transport properties***
3. ***Analytical detection levels are very low so contamination of samples with PFAS-containing material such as fibers shed from stain-resistant clothing, and cross-contamination between samples and sampling equipment, must be prevented***
4. ***PFAS remain in source zone soil and water long after the PFAS source has been removed. Many FTAs that were last used decades earlier still can have large PFAS concentrations, even after sites have been remediated for other chemicals***
5. ***Analytical methods are currently limited to certain PFAS, but other PFAS present at the site may have implications for risk and remediation***

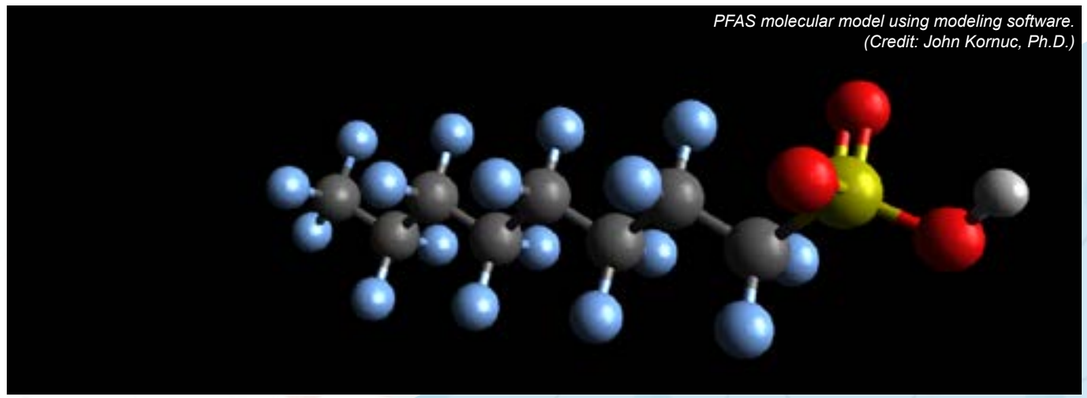
PFAS Has Unique Chemical Properties That Make a Unique PFAS Structure

The general structure of a PFAS molecule consists of a carbon “tail” or “carbon chain” of varying length, where the carbon is bound to fluorine (in place of hydrogen as it would be in hydrocarbons), and a “head group” often composed of a charged moiety such as a carboxylic acid or sulfonic acid.

The tail is hydrophobic while the head group is hydrophilic, often being charged at environmentally relevant pH (the charge can vary with pH). The hydrophobic tail wants to be out of water, while the hydrophilic head group wants to be in water. This often leads to the molecule positioning itself in such a way to satisfy both the tail and head by finding the interface between water and air. This is where the PFAS concentrate, be it on the water surface or on bubbles. PFAS are therefore known as “surface active” compounds.

The PFAS molecules orient themselves doing a kind of headstand, with the polar head group in the water, and the hydrophobic carbon-fluorine tail sticking out of the water into the air. The tail is also somewhat “stiff” and unlike a hydrocarbon chain, which can fold on itself. The much larger fluorines, with their strong and short bond to the carbons, fill the space between carbons, stiffening the chain. It is this surface active behavior which causes PFAS, when mixed with water, to create a protective coat over fuel, preventing oxygen from accessing the fuel and combusting the fuel.

> *If all of the carbons except the carbon(s) bound to the head group are bound to only fluorine (and each other carbon) then we call them perfluoroalkyl substances.*
>
> *If one or more carbon is not fully substituted with fluorine, and instead is bound to another element (typically hydrogen or oxygen) then these are called polyfluoroalkyl substances.*



PFAS molecular model using modeling software. (Credit: John Kornuc, Ph.D.)

PFAS-

What Is It and What Do We Know About It?

PFAS Characterization Continued...

Carbon Chain Length and Branching

PFAS tail length, the number of carbons in the carbon chain, contributes to how quickly a PFAS moves through the environment. Longer tail lengths, or higher carbon count, results in a larger molecule which is less mobile. PFOS and PFOA are C8 PFAS, eight carbons in each molecule (however PFOA has only 7 carbons in the tail since one carbon belongs to the carboxylate moiety). The hydrophobic tail also interacts with the organic content of soil—the longer the tail, the greater the interaction and the more retarded the transport. Shorter carbon tails, such as the C4 compounds PFBS and PFBA, transport at higher rates. These compounds are often at the leading edge of groundwater plumes.

The tails may be either linear or branched. The linear form has a greater hydrophobic character, having more hydrophobic surface area. Branched forms, or branched isomers, trend toward a more spherical shape, having a lower surface area per carbon so there is less hydrophobic interaction with soil organics and therefore transport is less retarded and the branched forms migrate faster. These branched forms move faster through the environment. Branching of the tail also tells something about the AFF source.

The PFAS in the first formulation from a manufacture of products containing PFAS, was produced using a chemical synthesis called electrochemicalfluorination (ECF). This resulted in a mixture of linear and various branched forms of PFOS and other PFAS in a ratio of about 70:30. When PFAS are found and the branched form is present, it is an indication that an ECF-specific product was used at the site, and the branched forms would have migrated faster and further. The PFAS level in this formulation was very high. If only unbranched PFAS are found at a site, this is an indication that non-specific products were used at the site, as the other manufacturers, to avoid patent infringement on processes, did not use ECF to produce their PFAS.

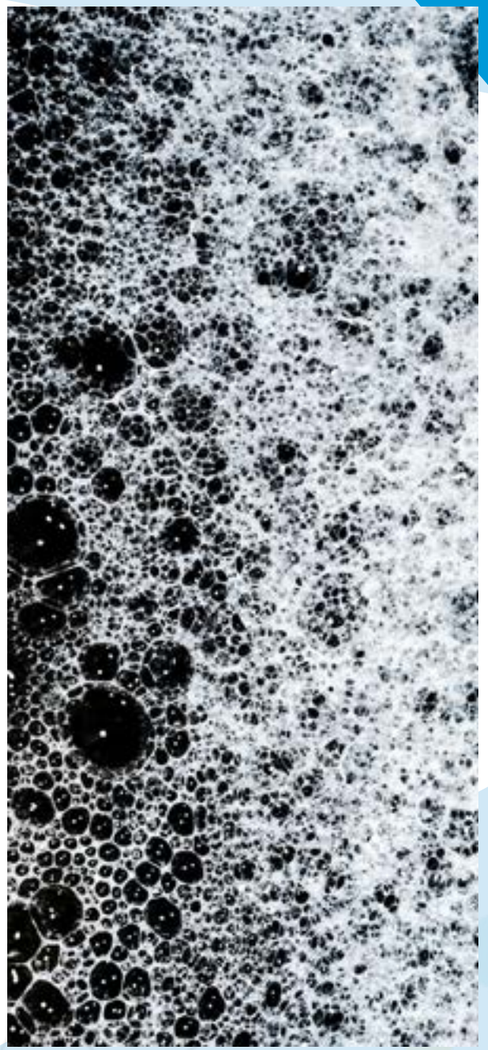
The fluorotelomer PFAS also contain one or more carbons unsubstituted with fluorine (hydrogen or oxygen typically takes the place of fluorine) nearest the head group. The unsubstituted carbon(s) present a “weak spot” in the chain where chemical and biological attack can occur and degradation can take place. Degradation of these fluorotelomer PFAS under normal environmental conditions can, however, lead to the formation of PFAS-like PFOS and PFOA, or their shorter-chain analogs like ***perfluorohexane sulfonic acid*** (PFHxS) or ***perfluorohexanoic acid*** (PFHxA), PFAS that are currently of regulatory concern due to suspected toxicity.

The Head Groups of PFAS

Perfluoroalkyl substances typically contain either carboxylate or sulfonate head groups (the charged forms of carboxylic and sulfonic acids which exist at environmentally relevant pHs). Collectively these are called ***perfluoroalkyl acids***, or PFAAs. Those with carboxylates are ***perfluoroalkyl carboxylates*** (PFCAs) and those containing sulfonate are ***perfluoroalkyl sulfonates*** (PFSAs). Generally, PFCAs travel faster than their sulfonate analogs of the same carbon count. Thus, PFOA tends to travel faster than PFOS, owing to the greater solubility of the carboxylate versus the sulfonate.

A large variety of other head groups are found in fluorotelomer-based polyfluoroalkyl substances. These are much less well studied than the PFAAs and more varied. This is due to the lack of analytical standards for most of the fluorotelomer-based PFAS, with most only having been recently described by research laboratories. Of these, several fluorotelomer sulfonates are often found at high levels at AFFF-impacted sites and are now included in analytical lists for standard laboratory methods (drinking water only) and their derivatives (all other matrices).

The fluorotelomer sulfonates are believed to be transformation products of other fluorotelomer-based precursors, as they are not found in AFFF formulations, and only have been relatively recently discovered at elevated concentrations at AFFF-impacted sites.



PFAS photograph taken at close range. (Photo credit: Ben Rasmussen)

PFAS-

What Is It and What Do We Know About It?

PFAS Characterization Continued...

PFAS Research: A Characterization Case Study

In a recent Environmental Security Technology Certificate Program and Navy Environmental Sustainability Development to Integration (NESDI) Program-funded study carried out by NAVFAC EXWC, FTAs were sampled using high-resolution techniques for both sampling and analysis. A large number of co-located soil and groundwater samples were collected, some only inches apart (particularly where soil type transitions occurred). Samples were analyzed using advanced analytical techniques that determined the presence and concentrations of over 300 PFAS known to be associated with AFFF or their impacted sites. The objective was to determine the distribution of the larger population of PFAS from AFF (and potentially other sources) that are distributed at the site, accounting for all or most of the total PFAS at the site.

A wide variety of PFAS were detected, especially at an FTA site at NAS Jacksonville. Differential transport and partitioning of PFAS between soil and groundwater was determined, including a large fraction of PFAS not included in current analytical lists due to the lack of standards (their concentrations are semi-quantified or estimated) and lack of standardized analytic techniques. The PFAS included cationic and zwitterionic (having both positive and negative charged functional groups on the same molecule) compounds. Current commercial laboratory techniques only analyze anionic PFAS, most of them PFAAs as previously described. It was found that in the source zone, ECF-derived sulfonamide PFAS (zwitterionic compounds) accounted for greater than 90% of the total PFAS mass. This represents a significant mass of PFAS which are bound to the source zone soils by ionic interactions (clay particles in soil usually carry a net negative charge, so bind positively charged groups of zwitterionic and cationic PFAS). It is suspected that these sorbed PFAS slowly transform into more mobile species over time, as structurally similar compounds were found downgradient of the source zone in groundwater. In addition, it was found that PFAS were at elevated concentrations in low permeability soils at the source zone, but downgradient these low permeability soils served to attenuate the transport of PFAS. A 3-D model of the site was constructed using the high resolution sampling data, and total PFAS mass was calculated (222 kg site-wide, though most mass is in or very near the source zone), as was mass for various PFAS classes. Based on the modeling, mass discharge was calculated over various portions of the plume and it was determined that the high concentrations found in the source zone are depleted by less than 2% per year. This is consistent with the observation that PFAS persist at sites long after the input source is removed. In addition, the probable transformation of precursors in the source zone, including zwitterionic and cationic PFAS sorbed to soils, contribute to the dissolved plume for periods far exceeding other chemicals. This, together with the very low regulatory guidance values for PFAS, suggest that these source zones can contribute to PFAS plumes for periods far exceeding other chemicals.

In addition to the high resolution laboratory analysis of PFAS, a total fluorine method was demonstrated in this project called Particle-Induced Gamma-ray Emission (PIGE) spectroscopy. This is a method that uses a beam accelerator to excite the nuclei of various elements in a solid sample, causing gamma-ray emission of characteristic frequency for each element. In this way, total fluorine can be quickly determined which corresponds to total PFAS. Each sample only requires 2-3 minutes to analyze. The results were used to guide the field sampling program, and correlated well with the high resolution mass spectrometer analysis of split samples. Total PFAS techniques such as PIGE, Total Oxidative Precursor, or Total Organofluorine analysis can be useful to complement commercial laboratory results as they provide an indication of the full suite of PFAS present at a site, and not only those 15-25 compounds on current analytical lists.

Courtesy U.S. Navy photo

Final Thoughts on PFAS Characterization

In closing, what we know about PFAS is exceeded by what we don't. The myriad compounds at our sites, many which are not currently detectable using available analytic techniques, limit our fate and transport understanding for these compounds, and therefore exposure risk. To definitively quantify these PFAS, standards will also need to be made available, together with rigorously tested new analytic techniques. Moreover, even knowing the distributions of all PFAS across a site is not enough in itself. In order to determine risk, toxicity information must be developed for these compounds, and that work has only recently begun for a relatively small number of compounds. It will be some time until we have the necessary information to accurately assess sites in a holistic fashion. In the meantime we can rely on what we do know, which is significant, to limit exposure to receptors and control the expansion of plumes by various approaches, including remediation which is described in the following sections.

PFAS-
What Is It and What Do We Do About It?

PFAS Remediation

PFAS Remediation Technologies

Written by: Jovan Popovic, Ph.D., NAVFAC EXWC Environmental Engineer

Over the past decade, the DOD has funded several projects that broaden our understanding of PFAS behavior in the environment, as well as those that investigate novel remedial strategies for groundwater and soils alike. Given considerations regarding PFAS molecular stability, this chemical class is mostly resistant to biodegradation in the environment, therefore requiring innovative and economical approaches to be implemented to manage PFAS across the vast range of impacted sites contained within the DOD's portfolio.

Environmental PFAS treatment technologies currently being developed fall under three broad categories: separation/media transfer, destruction, and attenuation. Separation/media transfer is a process similar to what is commonly found in home water filtration systems, where chemicals can be removed from water through binding interactions with filtration media (e.g. activated carbon) or separated from water by membranes (e.g. reverse osmosis). Destructive processes, on the other hand, involve the application of high temperatures and/or pressure or high energy acoustics (sonolysis), electrochemical, or plasma to break apart PFAS molecules. Incineration is an example of a high temperature destructive process that has been shown to destroy PFAS in both soils and liquid; in contrast, technologies such as sonolysis, electrochemical, and plasma have only been successfully demonstrated with PFAS-containing liquids, such as groundwater. Lastly, on-site PFAS attenuation has very recently been investigated as an alternative remediation approach for PFAS site management, where PFAS may be naturally or artificially sequestered on-site to prevent plume migration to potential off-site receptors. Since PFAS attenuation is still emerging as a viable PFAS remedy, subsequent sections in this article will describe both separation and destructive processes and their applicability to groundwater remediation at Department of the Navy sites.

Courtesy U.S. Navy photo

PFAS Groundwater Treatment

Groundwater has been one of humankind's most important natural resources for millennia since it plays a significant role in sustaining life across many regions of the world. In the event of chemical release to groundwater aquifers, various corrective measures must be taken to eliminate potential exposure to humans and other biota. In the context of PFAS release to groundwater and its relevance to the DOD, eliminating impacts to potential drinking water sources and preventing secondary PFAS release from construction dewatering operations and investigation derived waste are of greatest concern. The unique chemical composition of PFAS renders many conventional treatment processes ineffective, and to address this, the DOD has been actively pursuing appropriate water treatment technologies specifically tailored towards PFAS. PFAS chain length and head group interactions play a key role in the effectiveness of PFAS-impacted water treatment operations, and since multiple PFAS formulations have been utilized over the past several decades, it is important to take into consideration functional characteristics of different types of PFAS species contained within groundwater during remediation process design.

To gain a better perspective, a typical PFAS molecule can be thought of as an object containing a charged "head" group that prefers to stay in water ("hydrophilic") and a tail that repels water ("hydrophobic"), where either may participate in "sticky" interactions with other materials, such as filtration media. PFAS with longer tails tend to repel water better (are more hydrophobic) than those with shorter tails. The hydrophobic—or water repelling—characteristics of these molecules make certain filtration media more attractive for removing long chain PFAS, especially if the filtration media contains hydrophobic binding sites. Short chain PFAS, such as PFBS and PFBA, are less hydrophobic and rely primarily on the head group to bind to specific sites on the filtration media that attracts PFAS molecules. In general, long chain PFAS can be filtered out of groundwater more readily using conventional filter media, such as granular activated carbon (GAC), since GAC contains several hydrophobic and other charged sites on its surface and pores that can bind to both the charged head and hydrophobic tail of the long chain PFAS molecule. Short chain PFAS, on the other hand, have better affinity for filter media containing more charged active sites, such as certain ion exchange resins and ionic polymers.

Several commercially available water filtration media tailored towards PFAS removal have emerged on the market over the past few years, and due to the diversity of site conditions across Navy installations, one of the biggest challenges for the Navy is determining which sorbents and/or resins may be most effective for PFAS removal, such as heterogenous assortment of water chemistries. NAVFAC EXWC has been addressing these concerns through NAVFAC Headquarters, NAVFAC Far East, and Naval Innovative Science Engineering and NESDI. In particular, NESDI Project 555 and a NAVFAC Headquarters funded project are assessing site-specific PFAS removal performance with multiple sorbents and resins, either commerciallly available or still in development, at both the lab and pilot scale (Figures A and B).

PFAS-

What Is It and What Do We Do About It?

PFAS Remediation Continued...

***Figure A**: Laboratory-scale treatability testing for PFAS removal performance from groundwater using various commercially available sorbents – NESDI Project 555. (Courtesy U.S. Navy Photo)*

***Figure B**: Pilot-scale scorption unit processes used to treat PFAS-impacted groundwater at an undisclosed Navy site – NAVFAC Headquarters funded project. (Courtesy U.S. Navy Photo)*

What is Sonolysis?

Sonolysis (Sono – sound; lysis – loosening, dissolving) is an acoustic destructive method that delivers high frequency sound waves to liquid media, generating microscopic vapor bubbles referred to as cavitation bubbles. Acoustic waves can be generated using either plate or probe transducers to deliver a desired frequency to the liquid media, commonly contained within a bath. With respect to PFAS, thermal decomposition during cavitation is thought to be the primary mechanism through which these compounds undergo destruction during sonolysis, as temperatures within the cavities of violently collapsing cavitation bubbles can reportedly reach temperatures greater than 9,700 oC (~17,500 oF). In addition to these high temperatures, it has been extensively documented that other “excited,” destructive molecules can be formed during sonolysis, providing a wider array of available destructive mechanisms for PFAS.

NAVFAC EXWC’s Remediation Involvement

Recently, EXWC and GSI Environmental constructed a mobile pilot-scale PFAS treatment and destruction trailer containing a multi-transducer sonolysis bath with atmospheric control (Figure C). Variability with respect to reactor control will allow for greater flexibility across a broad range of sites with PFAS-impacted groundwater. This technology demonstration is currently ongoing at an undisclosed former fire training area managed by the Navy.

***Figure C**: NAVFAC EXWC’s pilot-scale sonolysis reactor used in PFAS destruction applications. (Courtesy U.S. Navy Photo)*

About the Authors

John Kornuc, Ph.D.

John Kornuc, Ph.D. recieved his Bachelor of Science in Microbiology from Ohio State University, and a Ph.D. in Biochemistry from the University of California Los Angeles. Kornuc has worked in the environmental field for nearly 40 years, starting with site characterization at Los Angeles area oil refineries. Seeing several feet of fuel floating on groundwater during samply collection hooked Kornuc into the environmental field, which led to method development for vapor sampling under buildinngs overlying the fuel plume, gas chromatographic forensics, and remediation using soil vapor extraction. He soon branched out into other industries, and helped develop various characterization and remedial methods, including soil gas surveys, leak detection of underground storage tanks, and vapor extraction-assisted bioremediation. Kornuc’s childhood Tonka truck dreams came to fruition when he learned to operate heavy equipment during numerous underground storage tank removal projects, and that experience proved useful for everything from homebuilding to further development of soil remediation—and getting a contractor’s license. Kornuc and two colleagues started their own environmental consulting company in the early 90s before starting as a contractor with the Navy, then ESC. Eventually, Kornuc transitioned to a civil service position at NAVFAC EXWC, and has worked on various environmental areas, including constructed wetlands, dredged sediment treatment, undersea cable impacts, and for the past 8 years or so, has focused on PFAS.

Jovan Popovic, Ph.D.

Jovan Popovic, Ph.D. is an environmental engineer at NAVFAC EXWC in Port Hueneme, CA. At NAVFAC EXWC, Popovic has been involved with a variety of environmental restoration projects, covering topics including PFAS treatment technology development, 1,4-dioxane treatment, as well as attenuation of petroleum hydrocarbons, munitions constituents and PFAS. Prior to joining NAVFAC EXWC, Jovan completed his postdoctoral training at University of Minnesota’s BioTechnology Institute where he performed research on understanding electron transfer interactions between electrogenic microorganisms and pyrogenic carbon, developing pyrogenic carbon-based biosorbents with immobilized sulfate reducing bacteria for the treatment of heavy metals in mining-impacted waters, and developing cathodic denitrification systems for nitrogen removal in agricultural runoff. Popovic completed his Ph.D. at Clemson University in 2015, where his primary research focus areas were aligned with the application of electron-cycling strategies to enhance wild-type microbial metabolism and discovering novel microbes for the bioremediation and bioprocess industries. training area managed by the Navy.

EXWC in the News

Debut Microgrid Academy Completes Phase 2 Training

Focus Area: Develop the Workforce

Debut Microgrid Academy Completes Second Phase of Hands-On Instruction

Written by: Sarah G. MacMillan, NAVFAC EXWC Deputy Public Affairs Officer & Mina B. Sharobim, P.E., NAVFAC EXWC Electrical Engineer

PORT HUENEME, Calif. – Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC) Public Works Department (PWD) completes the second phase of their debut Microgrid Academy for the Department of Defense (DOD) armed forces and civilian personnel.

Back in November 2020, NAVFAC EXWC PWD hosted the first phase of the two-phase debut Microgrid Academy. 46 participants from across the armed forces attended first phase instruction virtually. By adhering to COVID-19 procedures, the second phase of Microgrid Academy is more intimate, spanning 8 hours a day for 3 days. The instruction is hands-on at Naval Base Ventura County (NBVC) in NAVFAC EXWC buildings and at the microgrid test bed within the Mobile Utilities Support Equipment yard.

Instructors work at a variety of military commands and government agencies, including NAVFAC EXWC, Naval Station Rota, and the Electric Power Research Institute.

Many of the students attending the Microgrid Academy are new to the complexity of the Microgrid Academy training but have a reasonable amount of energy utilities knowledge. Some students however, are new to microgrid technologies and their operations altogether.

Right photo: NAVFAC EXWC Microgrid Academy students pose outside the microgrid test bed in Port Hueneme, Calif. (photo credit: Robert Nordahl, P.E.). Left photo: NAVFAC EXWC Microgrid Academy students explore energy utility computer modeling (photo credit: Robert Nordahl, P.E.).

There are several objectives for students attending the second phase of the Microgrid Academy, including training on the microgrid decision support software used by the Navy and Army—known as XENDEE.

XENDEE—designed by microgrid engineers, software developers and energy experts—helps military planners and mission critical facility operators simulate scenarios in various stages of microgrid design, including feasibility studies, financial optimization, and technical validity and project implementation. The configurations students simulate include current microgrid systems managed by NAVFAC EXWC at NBVC's San Nicolas Island (SNI) and NAVSTA. Both SNI and N utilize energy, energy storage, and microgrid technology to improve resiliency against potential energy outages, and reduce energy costs.

Students also spend time partaking in hands-on training at the microgrid test bed, where they work with testbed controls, battery energy storage systems—known as BESS units—and monitoring systems to understand how microgrid systems operate in real-world applications. Students also learned about the safety, operation, and maintenance requirements to keep BESS units operating properly, inside specification.

Since the debut of the Microgrid Academy, instructors have gleaned feedback from students on course curriculum options, which leads to collective high-level discussions with students with all levels of microgrid knowledge. These high-level discussions also provide understanding for different DOD utility needs across various installations.

For more information on the NAVFAC EXWC Microgrid Academy and enrollment opportunities, please contact Robert Nordahl, NAVFAC EXWC Microgrid Academy Team Lead at *robert.nordahl@navy.mil*

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EXWC in the News

Phase 2 Microgrid Academy Training Focuses on XENDEE Modeling

Focus Area: Increase Agility

From Spain to Antarctica, Catered Microgrid Solutions are Becoming an Integral Part of Energy Infrastructure

Written by: Sarah G. MacMillan, NAVFAC EXWC Deputy Public Affairs Officer & Mina B. Sharobim, P.E., NAVFAC EXWC Electrical Engineer

PORT HUNENEME, Calif. – It has been widely reported that the Navy is dealing with aging energy infrastructure making it increasingly difficult for naval installations to be adequately prepared to meet their mission.

In of March 2020, the Navy set an accelerated course for installation resilience by implementing a new energy strategy, aptly named the "Installation Energy Resilience Strategy"—or IERS. IERS focuses on the delivery of uninterrupted, reliable and high-quality power necessary to meet the evolving mission requirements outlined in the Department of Defense (DOD) National Defense Strategy. Within the IERS, the Navy stated they must optimize the use of every available authority to accelerate the delivery of secure and reliable energy—and importantly, have assured energy whenever or wherever it is required. The strategy also adopted a resilience policy set to enable key military installations to go off-grid for at least two weeks by late 2025. This effort ensures military installations are independent of public utilities.

Even before the Navy ratified the IERS, Naval Facilities Engineering and Expeditionary Warfare Center, (NAVFAC EXWC) became engrossed in offering their customers a catered renewable energy source solution that is both reliable and resilient, combined with associative benefits of energy reduction and efficiency. In doing so, NAVFAC EXWC has continued to drive microgrid growth across military installations globally—including Naval Station Rota (NAVSTA ROTA) in Spain, the United States Antarctic Program (USAP) South Pole Station, and pending microgrid support for Naval Support Facility Diego Garcia, and Camp Lemonnier Naval Installation Command, Djibouti.

Recently, NAVFAC EXWC completed a large-scale modeling at NAVSTA Rota using the XENDEE modeling platform—or XENDEE.

XENDEE is a microgrid decision support software that helps designers optimize and certify the resilience and financial performance of projects. XENDEE—designed by microgrid engineers, software developers, and energy experts—have leveraged public, private, and XENDEE's proprietary research to develop the microgrid decision support software. Used by the Department of the Army and Department of the Navy to provide streamlined and secure microgrid planning and decision support, XENDEE offers insight into all four stages of microgrid design, including feasibility studies, financial optimization, technical validity, and project implementation. Military planners and mission critical facility operators specifically use XENDEE to pursue its specific informed energy strategies.

The XENDEE algorithm considers the entire energy resiliency problem, and generates a solution backed by mathematical analysis. The solutions offered by XENDEE focus on distributed energy system optimization, next-generation power system analytics, and optimal control strategies all under one integrated platform.

NAVFAC EXWC professionals at NAVSTA Rota used XENDEE to assess critical loads, provide meter data from critical buildings, and conduct a sensitivity analysis to determine necessary technology during an outage. The results from the large-scale modeling provided a solution for NAVSTA Rota to maintain power for up to one month. In the event of an outage, NAVSTA Rota will use the existing diesel generators and additional photovoltaics—the most economical, available and resilient solution.

In an effort to reduce cost and increase efficiency, NAVSTA Rota teams became interested in how much money can be saved if the base utilizes crude oil emulsified with water and solids—or SLOP fuel—and electric power from the base's new photovoltaic farm. Using the XENDEE, NAVSTA Rota teams ran worse case scenarios for energy production and more expensive tiered electricity rates. Teams ran multiple scenarios, including scenarios where ports were full of ships or nearly empty. By running these scenarios, teams have a better understanding of what technology is needed during a variety of outage scenarios.

In addition to the work at NAVSTA Rota, NAVFAC EXWC is preparing to conduct an energy study of the USAP South Pole Station. The energy study is looking to reduce reliance on fossil fuels and identifying the best value enhancements to USAP's resilient infrastructure. With upwards of 1,100 hours to conduct the energy study, NAVFAC EXWC microgrid professionals will use XENDEE to recommend the lowest lifecycle cost alternatives for future infrastructure investment.

Initially, microgrid professionals will conduct a remote investigation of all previous energy studies at USAP, and review existing pertinent South Pole Station information. NAVFAC EXWC will then use XENDEE to optimize a plan of action that minimizes costs. Teams will perform a load analysis and investigation of both current and future loads serviced at USAP buildings. This stage of the energy study will incorporate known future changes related to the pre-preproposal projects and work identified in the energy study's ongoing master planning effort. Microgrid teams will then use XENDEE to develop current and potential future states for USAP. The final energy study deliverable will be a model output that identifies the best technology options for USAP that lower lifecycle costs, improve emissions, and improve power reliability and resiliency.

Work at NAVSTA and USAP is just the beginning of an upward battle for the future Navy to self-produce low-cost, clean energy that will enhance local resiliency and improve operation stability. Commands like NAVFAC EXWC are driving the IERS towards productivity—making the need for renewable and sustainable energy an even greater priority for the Fleet than ever before.

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EXWC in the News

Contracting & Government Purchase Card Program Recieves Enterprise Praise

Focus Area: Develop the Workforce

Leigh Walker (left) & Jill Thomas (right)
Acquisitions Department

Theresa Lee
Contract Specialist

Mark Truax
Contract Specialist

Anthony Gonzales
Contract Specialist

NAVFAC EXWC Contracting and Government Commercial Purchase Card Program Receives Praise from Enterprise Audit Team

Written by: Jill Thomas, NAVFAC EXWC Chief of the Contracting Office & Danielle Kincaid, NAVFAC EXWC Director of the P&P Division

PORT HUENEME, Calif. – NAVFAC Headquarters Procurement Management Assessment Program (PMAP) team visited NAVFAC EXWC to conduct a contracting audit and a government-wide commercial purchase card (GCPC) program audit at the end of March, through the beginning of April.

The contracting audit consisted of reviews across three categories: organizational leadership, management and internal controls, and regulatory compliance. Additionally, the GCPC audit consisted of reviews across three categories: regulatory compliance (transactional reviews), internal management and controls (oversight), and other tested elements such as delinquencies, corrective actions, and property accountability. NAVFAC EXWC recieved satisfactory ratings on each of the contracting factors and passed each of the GCPC categories.

On the contracting audit, the team reviewed seventy actions taking a wide sampling across the NAVFAC EXWC contracting talent. They met with senior leaders and conducted a question and answer session with staff. The audit team also reviewed various contracting reports, newsletters, processes, and tracking mechanisms. For the GCPC program, the audit team reviewed 45 transactions and program oversight.

During the course of the audit, many positive comments were shared in the PMAP out-briefs. The PMAP team disccussed how the multiple contracting initiatives taken were impacting the organization positively. Some business decision documents reviewed were among the best the team had seen across the NAVFAC Enterprise. The PMAP team also stated that the workload report was a useful tool and noted that the communication and 'one team culture' contributed dramatically to NAVFAC EXWC's success.

In the GCPC PMAP out-brief, the reviewers said, "[NAVFAC EXWC] set the bar high for the rest of NAVFAC."

Reviewers recognized NAVFAC EXWC as a best practice in acquisition planning and the effectiveness of execution planning between contracting, the operations office, and technical directorate business lines. Reviewers also noted the sound management of the agency program coordinator, which shared file folders that were easily identified with the correct documentation for each transaction, and that the frequently asked questions sent to cardholders every Friday was adding value.

For more information on NAVFAC EXWC's Contracting Office, please contact Jill Thomas, Chief of the Contracting Office at *jill.thomas1@navy.mil*

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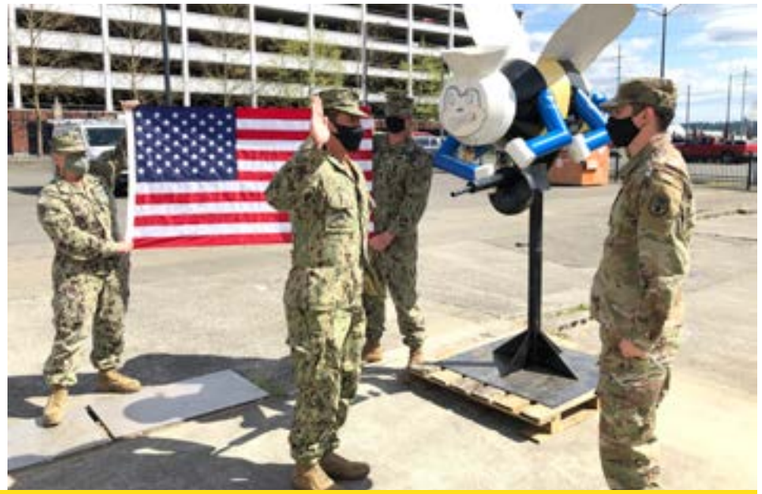
> *"Congratulations to the entire contracting department, and especially congratulations to GCPC lead Elizabeth Hecker!*
>
> *The contracting department is grateful to NAVFAC EXWC leadership, business lines, support lines and cardholders for their contributions to the successful audi results.*
>
> *NAVFAC EXWC continues to infuse PMAP recommendations across command acquisition management, and is committed to delivering compliant, quality and timely results for military customers, and ultimately the American people.*

EXWC in the News

MUSE Powers Dry Dock at Puget Sound Naval Shipyard

Focus Area: Increase Agility



MUSE Powers Dry Dock at Puget Sound Naval Shipyard, Participates in Impromptu Reenlistment Ceremony

Written by: Petty Officer 1st Class Jeremy Tatlock, NAVFAC EXWC MUSE

BREMERTON, Wash. – NAVFAC EXWC Mobile Utilities Support Equipment (MUSE) sent three technicians to install two 2500kVA pad-mounted transformers at Puget Sound Naval Shipyard (PSNS).

The equipment—that is pivotal to the shipyard's electrical backbone—will be used to support operations at the PSNS dry dock 2 pump-well during the execution of special project repair contracts for the main dewatering pumps, motor converts and substations.

Built in 1911, the pump house at dry dock 2 utilizes a legacy voltage 2300v, which is not support by most infrastructure in today's modern age. Due to the overlapping maintenance projects, Naval Base Kitsap Public Works Department (NBK PWD) quickly realized it was not feasible to operate the dry dock during this period, as the maintenance projects would negatively affect Fleet ships and submarines scheduled for depot level maintenance, and quickly contacted MUSE to implement a solution to their problem.

Left photo: CE1 Dewain Smith (middle) receits the oath of enlistment given by his younger brother, U.S. Army Capt. Brian Smith (right). (Photo credit: Petty Officer 1st Class Jeremy Tatlock) Right photo: U.S. Army Capt. Brian Smith (left) congratulates his older brother CE1 Dewain Smith (right) for reenlisting (Photo credit: Petty Officer 1st Class Jeremy Tatlock)

Alexander Burke, NBK PWD General Electrical Foreman said, "[MUSE's help] ensures the ability to dewater dry docks 1, 2 and 3 at PSNS. Without their help, we would have been dead in the water."

The successful installation of the equipment at NBK PWD allowed continued operations at dry dock facilities, which is a testament to the training and experience that MUSE technicians bring the Naval Construction Force (NCF) and Department of Defense.

During the installation, construction electrician Petty Officer 1st Class Dewain Smith, NAVFAC EXWC Detachment Officer in Charge, took the opportunity at NBK PWD to raise his right hand and take the oath of reenlistment, performed by his younger brother, U.S. Army Capt. Brian A. Smith.

"It is pretty amazing to have this opportunity and work in an environment that affords me to travel and cross paths with my little brother," said Petty Officer Smith.

MUSE technicians are regarded as the technical experts of the NCF. The technicians—who are hand selected to go through a rigorous yearlong training at the Army's Prime Power School—are called to problem solve and provide interim power solutions for commands all over the world.

To continue to be a valuable asset to the Navy and greater defense, MUSE technicians continue to provide the Fleet and defense facilities worldwide with interim power solutions that allow ships and equipment to be upgraded and overhauled, all while still operational for mission needs.

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> *A special thank you to Petty Officer 1st Class Jeremy Tatlock for his continued support of NAVFAC EXWC Public Affairs Operations.*
>
> *Petty Officer Tatlock understands the importance of communicating the NAVFAC EXWC story, and willingly jumps to the occasion to market the impactful work MUSE provides the Fleet.*

Asian American, Native Hawaiian and Pacific Islander Heritage Month

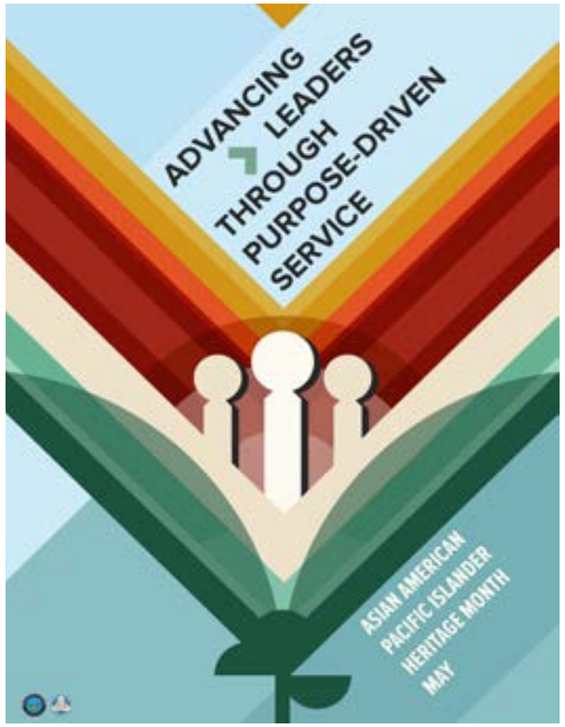
Asian American, Native Hawaiian and Pacific Islanders (AANHPI) have been honorably serving in the U.S. military since the War of 1812. The month of May, designated as Asian American, Native Hawaiian and Pacific Islander Heritage Month, is an opportunity for NAVFAC EXWC professionals to celebrate the contributions and diversity of the AANHPI within the Navy and the greater Department of Defense. Generation after generation, the AANHPI community has forged a proud legacy that reflects the spirit of the Sailor, and more importantly the spirit of the U.S.—a country that values the contributions of all persons who call America their home. Together, as we celebrate May's cultural observance, let us recommit to embracing the diversity of our Navy and our Nation to ensure all people—regardless of ethnicity—have an equal chance to prosper.

AANHPI Who Served

1 in 3 Asian American Veterans are 65+	**264,695** Veterans are Asian Americans
1 in 5 Native Hawaiian and Pacific Island Veterans are 65+	**27,496** Veterans are Native Hawaiian/ Island Pacificer
8,793 Native Hawaiian and Pacific Islanders are currently active duty	**52,433** Asian Americans are currently active duty

AANHPI in Higher Government

This past January, the Asian Pacific American Institute for Congressional Studies—or APAICS—hosted the Congressional Swearing-In Ceremony for AANHPI members and Congressional Asian Pacific American Caucus members of the 117th Congress. The ceremony served as a recognition of the increasing diversity of federal leadership. In particular, the ceremony celebrated the historic number of 21 AANHPI members serving in Congress today.



Top photo credit: Airman 1st Class Brieana Bolfing
Bottom photo credit: Airman 1st Class Daniel Blackwell

AANHPI Notable Military History

1815	General Andrew Jackson notes that Filipinos fought alongside forces in the Battle of New Orleans near the end of the War of 1812.
1863	Chinese-American John Tomney joins the New York Infantry. He later died of wounds during the Battle of Gettysburg.
1913	Samuel Amalu—Hawaii's renowned dean of lighthouse keepers—was the keeper of the Kilauea Light State (the northernmost lighthouse in Hawaii).
1944	Shigeo Uchino, a native Hawaiian, began his 30-year career with the Military Intelligence Service. Uchino ultimately earned the Purple Heart and Bronze Star for Valor, in addition to the Combat Infantry Badge.
1945	Chew-Een Lee, the son of Chinese immigrants, first enlisted in the Marine Corps. In 1950, Lee's platoon came under attack. Despite being outnumbered, Lee exposed himself to fire as he reconnoitered the area to redeploy his machine gun posts within the defensive perimeter.
1947	Florence Smith Finch received the U.S. Medal of Freedom, the highest civilian medal awarded to American citizens living abroad who aided in the war effort.
1994	Rear Admiral Eleanor Mariano—who was the first military woman appointed as a White House Physician—was named Director of the White House Medical Unit, serving as President Clinton's personal physician.
2000	Rear Admiral Eleanor Mariano became the first female Filipino American Navy Admiral.

What Is EXWC Up to?

The AWWA, Ventura Botanical Gardens, NavalX and More...

Focus Area: Increase Agility

U.S. Navy construction mechanics work on the Columbia water well during drilling operations in Riohacha, Columbia. Right and left photo credit: Petty Officer 1st Class Grant Ammon

AWWA Sponsors Managing Geologist and Hydrologist Joseph "Manny" Saenz, Presents to Colombia Water Well Installation

The American Water Works Association— or AWWA—invited Joseph "Manny" Saenz of the Expeditionary Programs Office to present Hydrogeologic Repository & Columbia Water Well Installation. In late March, Saenz discussed how over the past several years, NAVFAC EXWC has provided hydrogeologic and engineering technical support to several Naval Mobile Construction Battalions (NMCB)—one of which being NMCB 133 who successfully installed an 800-foot-deep water well in Riohacha, Colombia. As of 2020, the Columbia Ministry of Water informed the U.S. Navy that the Colombia water well effort turned out to be the only fresh water well in the drought-stricken region.

"Being a part of the AWWA of California/Nevada is an honor because the association is an international non-profit, scientific and educational supply. Through the advocacy of better well design, operation and rehabilitation techniques, the members are dedicated to providing total water solutions assuring the effective management of water, which relates to the warfighter's mission to provide facilities engineering design, siting, evaluation, maintaining construction, development and installation of water resource infrastructure," said Saenz.

Over 60 technical representatives across the U.S. attend Saenz's online presentation. Saenz will now regularly participate in the AWWA of California/Nevada.

Robert Nordahl, P.E. and Phil White pose outside the Ventura Botanical Gardens.

Ventura Botanical Gardens Welcome NAVFAC EXWC Public Works Professionals, Gives Tour of Fog Capture System

In early Spring, NAVFAC EXWC Public Works Department took a day-long field trip to the Ventura Botanical Gardens to meet with Phil White—former member of the Ventura County Planning Commission. The Ventura Botanical Gardens have implemented a capture fog system to collect water from fog. Simply put, the capture fog system uses a pilot plant, and one square meter piece of fabric to capture water from fog. The intent for the water collected from the pilot plat is to water the African garden plants at the botanical gardens that require the cleanest of waters. As testing nears completion, the pilot plant will be largely scaled, following a fence going up a vast hill in Ventura.

Teams at NAVFAC EXWC believe the Navy Seabees could use a similar process as the pilot plant at the Ventura County Botanical Gardens to capture fog to create usable water in remote locations.

NAVFAC EXWC tours MCAS Miramar large microgrid system transpower.

Microgrid Professionals Meet With MCAS For Tour of Small Transpower and Installed Microgrid

In early March, NAVFAC EXWC Public Works Department met with the Marine Corps Air Station Miramar Utilities and Energy Management Team. The field trip consisted of a tour of MCAS Miramar's installation of both their larger microgrid system and smaller transpower microgrid.

The installation of the larger MCAS Miramar microgrid is designed to sustain full operations of the MCAS Miramar installation during power disturbances—which includes 36 square miles (or roughly 15,000 people) with 6.45MW capacity of uninterrupted power until service is restored. The microgrid can also operate under three different modes of operation: economic mode, emergency islanded mode, and test island mode.

NAVFAC EXWC teams believe the state-of-the-art MCAS Miramar microgrid system offers a series of lessons and best practices that could be implemented at Naval Base Ventura County's micrgrid testbed and San Nicolas Island to further energy storage resiliency.

Expeditionary teammates pose at MCAS Miramar during NavalX event.

EXWC Expeditionary Team and NavalX Conduct Counter Intrusion and UAV Collison Event

In late March, NAVFAC EXWC's Expeditionary Programs Office assisted NavalX in conducting the Multi-Domain Counter Instruction Collision Event. Taking place at MCAS Miramar, the event brought together partners across the United States Marine Corps—including the Marine Corps Systems Command and Marine Corps Warfighting Lab—to demonstrate intrusion systems that apply sensor fusion, computer vision, and machine learning to increase effectiveness and reduce cognitive burdens on operators; also known as artificial intelligence enabled force protection capabilities. The exercise provided the Marine Corps the opportunity to validate the application of artificial intelligence platforms to improve situational awareness for installation base defense. Looking forward, the data collected from the successful event will inform future Navy and Marine Corps counter-intrusion capability requirements, and demonstrate the concept of an integrated family-of-systems approach to counter intrusion operations and installations.

What Is EXWC Up to?

Groundwater Research, NAVFAC Community STEM Event, DRUM-E Award Recipient and More...

NAVFAC EXWC's Environmental Restoration Team Aids to Combat Groundwater Discharge to Surface Water in Recent Evaluation

A former Naval Construction Battalion Center located in Davisville, Rhode Island was chosen for a comprehensive evaluation of the decrease of chlorinated volatile organic compounds—or CVOCs—at the groundwater to surface water interface (GW/SWI). NAVFAC EXWC engaged in the effort to address these complex sites within the Navy's Environmental Restoration (ER) portfolio. The comprehensive evaluation targeted specific questions, such as evaluating and verifying the presence or absence of seeps in coast and freshwater environments. Other challenges reviewed during the comprehensive evaluation include demonstrating the decrease of a dissolved phase plume, which has the potential to occur at a GW/SWI. Teams at Davisville identified and confirmed groundwater seeps and provided an analysis of their findings. During their evaluation, several innovative tools were specifically chosen and deployed to Davisville. The tools chosen measured groundwater flow and biological parameters in pore water samples. These include trident probes, an UltraSeep System, differential pressure piezometer, and a high-resolution passive profiler. The demonstration resulted in substantial evidence that the natural decrease of CVOCs is occurring at Davisville. Teams additionally reported that the use of the innovative tools offered high-resolution sampling, ease of estimating contamination discharge, among other positive benefits shared with the Navy's ER Program.

Upcoming Live Event – Research and Collaboration: Building New Skills in the NAVFAC Community

Happening early fall, NavalX welcomes the NAVFAC community and university partners to Research and Collaboration: Building New Skills in the NAVFAC Community—a live event to educate and guide command science, technology, engineering and math efforts to invest in the Navy's future. The live event—moderated by NAVFAC EXWC—will introduce the exciting project partnership between NavalX and the NAVFAC Enterprise, known as the NAVFAC Semiannual Project List. The NAVFAC Semiannual Project List offers industry and academia the opportunity to collaborate on funded research projects that are important to the Navy. The curated NAVFAC Semiannual Project List is a collection of research topics that Civil Engineer Corps Officers can select for graduate research. In 2020, 24 students completed a research project from the NAVFAC Semiannual Project List. Those who completed the research project briefed their findings to NAVFAC leadership. Speakers for the upcoming live event will include leadership from NAVFAC Headquarters, NAVFAC Pacific, NAVFAC Atlantic and NAVFAC EXWC.

NAVFAC EXWC Public Works Department energy utilities team and NBVC High Voltage Shop completes repairs at MUSE.

NBVC Utilities and Energy Management Team Flip the Breakers On at MUSE

Naval Base Ventura County's Utilities and Energy Management High Voltage Shop led by Ray Hughes, recently completed repairs at the NAVFAC EXWC MUSE yard substation. Thanks to everyone involved, the NAVFAC EXWC Microgrid Test Bed is now isolated from the MUSE building, which runs an independent circuit. Previously, teams at the microgrid test bed repeatedly tripped the MUSE building off grid by triggering sensitivity settings on the common breaker. As of today, all issues have been successfully mitigated, by switching the system over to a separately dedicated breaker at the MUSE substation. The new breaker will allow the microgrid test bed team to safely draw more current from their system, enabling them to conduct more independent testing at the MUSE yard. Microgrid test bed teams are also eager to run new tests at the microgrid test bed that were previously not possible on the old system configuration.

> *This revised wiring will certainly 'pay off' not only [for] the EPRI battery energy storage system and EPRI microgrid testing, but it will [also] benefit all future microgrid and/or battery testing at the [NAVFAC EXWC] Microgrid Test Bed Facility.*
>
> *– Dr. Robert Schainker, EPRI Senior Technical Executive*

Kelsey Pauxtis-Thomas, NAVFAC EXWC Technology Transfer Lead, Environmental Security Department

Environmental Restoration Employee of the Year Receives DRUM-E Award for Exceptional Performance

Kelsey Pauxtis-Thomas, NAVFAC EXWC Technology Transfer Lead and Environmental Restoration (ER) Employee of the Year, received the DRUM-E award for her exceptional performance and contributions to the NAVFAC ER Program. Notably, Pauxtis-Thomas received recognition for her key roles in designing the ER and Base Realignment and Closure webpage. Pauxtis-Thomas' leadership and contributions within the technology transfer program are also dutifully noted.

The DRUM-E award is named after the miniature oil drum-shaped trophy given to winners of the DRUM-E award; the 'E' stands appropriately for 'environmental'. Given annually to one person from each of NAVFAC's echelon III and IV offices, the nomination process for the DRUM-E award requires approval from NAVFAC Headquarters, with selection criteria based on the nominees' contributions to the enterprise. Contributions include efforts as a remedial project manager, teamwork and leadership skills, high-level coordination efforts within their respective positions, and cost-saving efforts for the EV program.

A Quick Conversation With NAVFAC EXWC Sea & Shore Sailors of the Year

NAVFAC EXWC is proud to announce our 2021 Sailors of the Year!

CE1 Amberleigh Cantrell of Mobile Utilities Support Equipment is awarded as NAVFAC EXWC Sailor of the Year for sea; CM1 Ian Lemarbre of the NAVFAC EXWC Dive Locker is awarded NAVFAC EXWC Sailor of the Year for shore.

CE1 Cantrell and CM1 Lemarbre have proven to be very effective leaders—especially during COVID-19 staffing challenges—make them ideals picks for each award. The pool of candidates for both awards were extremely qualified, however, CE1 Cantrell and CM1 Lemarbre's professionalism and aptitude in their respective fields make them not only an asset to the NAVFAC enterprise, but the entire federal workforce.

NAVFAC EXWC Public Affairs Office virtually sat down with CE1 Cantrell and CM1 Lemarbre to discuss their work at NAVFAC EXWC and what the Sailor of the Year Award means to them.

MacMillan: Congratulations to you both on your selection as NAVFAC EXWC Sailor of the Year for Sea and Shore! I promise these are easy ball questions; let us get started. What does earning this achievement mean to both of you?

CE1 Cantrell: Earning NAVFAC EXWC Sailor of the Year for Sea means that my Chain of Command has the confidence in my abilities and professionalism—that means I must be doing something right!

CM1 Lemarbre: To be the NAVFAC EXWC Sailor of the Year for Shore means a lot to me. There are countless motivated and hardworking sailors who deserve this award, and to be selected over them is a great honor. I honestly would not be here if it was not for all the support and hard work from everyone that I work with.

MacMillan: In your respective departments, what part of working at NAVFAC EXWC do you enjoy the most?

CE1 Cantrell: I work in the Mobile Utilities Support Equipment engineering branch, and being able to help develop a piece of electrical support equipment from cradle to grave, and seeing the impact it has on the fleet is the most fulfilling work I've done so far in the Navy.

CM1 Lemarbre: I really enjoy seeing the future technology that will someday be integrated into the Navy diving community. To be on the forefront of new and emerging technology within the Naval Construction Force and within the diving community is very exciting.

MacMillan: This is a loaded question but looking into the future, where do you hope to be in the next 5 years?

CE1 Cantrell: I would like to see myself inspiring others no matter what path I take in my career. I expect to continue growing in my technology knowledge, as well as through the ranks, however, inspiring others and taking the initiative to improve the Navy's processes and personnel are the most important things to me in the Navy—and I would like to continue that.

CM1 Lemarbre: I plan to make Chief Petty Officer, and after a few years, I would like the become a master diver.

MacMillan: Are either of you working on any projects or are you working in a position that you find challenging—in a positive way?

CE1 Cantrell: Currently I am managing and monitoring a contract for two 18MVA substations that will support the new Gerald R. Ford aircraft carrier. It is challenging because there are a lot of moving parts to managing a contract this big, as well as the fact that this substation is a never-before-seen piece of gear in the Navy. It is extremely rewarding to have a direct hand in the design and construction of the unit, as well as be onsite at the customer's location to install the unit for them.

CM1 Lemarbre: I have been managing five different research, development, testing and evaluation efforts, as well as keeping up with the dive projects and everyone's dive qualifications on a daily basis. This is quite the challenge, but the motivation and professionalism of the NAVFAC EXWC Dive Locker personnel make my job that much easier.

MacMillan: Do either of you have any words of advice for novice Sailors looking to move up in the ranks?

CE1 Cantrell: Yes—keep striving to grow personally and professionally. Do not pass up any opportunity the Navy gives you. Finally, strive for that sustained superior performance in many areas of your career.

CM1 Lemarbre: I would say do not be afraid to fail. Failure is the best tool for learning, also, listing to your troops—everyone knows something that you do not.

MacMillan: Alright, we need to make sure we call out who has supported you during your Navy career.

CE1 Cantrell: My husband and fellow Seabee—CM2 Nickolas Stockwell—has supported me through my whole career and transition into the Mobile Utilities Support Equipment branch. I would not be doing the work that I do without him—he pushes me to be better.

CM1 Lemarbre: My wife and my parents are my biggest supporters. They are always pushing me to learn and take on new and difficult tasks, and they are always there to help me back up when I fail or when something is not going as planned.

MacMillan: Any final thoughts to share with our EXWC EDGE readers?

CE1 Cantrell: Yes—In our line of work (supporting the warfighter), I think it is super important to ensure you are taking care of yourself. Our job can be stressful, as well as rewarding. I beg everyone to remember that you cannot take care of others properly if you do not take care of #1 (YOU) first! I do not mind telling others that I attending counseling, not just for mental health reasons, but also as a way to get an outside perspective on how I operate and how I can operation more efficiently. I believe counseling, at its core, is about self-improvement… and we can all benefit from that.

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The ***EXWC EDGE*** is always looking for fresh, applicable and compelling new content for our bi-monthly publication. Issue #0007 will launch in early July 2021. Please send your contributions before June 1, 2021 for inclusion.

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In advance, thank you for contributing!

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Accelerate innovation to enable fleet lethality at sea and ashore

MISSION

Provide research, development, testing and evaluation and in-service engineering to deliver specialized facility and expeditionary solutions to the warfighter

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We serve our warfighters and our nation with Honor, Courage, and Commitment

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