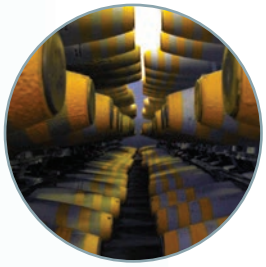



2014

YEAR IN REVIEW REPORT

Accomplishments of the Navy Environmental Sustainability Development to Integration Program

Accomplishments of the
Navy Environmental
Sustainability Development
to Integration Program

For more information about the NESDI program, visit www.nesdi.navy.mil.

Contents

A Word From Our Program Manager

Welcome to the Navy Environmental Sustainability Development to Integration (NESDI) program's Fiscal Year (FY) 2014 Year in Review report.

Ken Kaempffe
Program Manager

This is my first Year in Review report as the new NESDI program manager and as such, I'd like to thank my predecessor, Leslie Karr, for her many years of dedicated service to the Navy and the NESDI program in particular. She initialized several important process improvements, including a new needs screening process, timing field visits to correspond with our annual In-Progress Reviews (IPR), and a continuing focus on integration, the ultimate goal of all of our efforts.

Immediately before coming to the NESDI program, I served as the head of the Environmental Technology Transfer and Central Programs Branch at the Naval Facilities Engineering and Expeditionary Warfare Center where I supervised a staff of 17 engineers and scientists in program areas including scientific diving services, environmental compliance technology transfer, environmental planning consultation, the Oil Spill Response Equipment Program, as well as installation reimbursable and research, development, test and evaluation (RDT&E) projects. As a Branch Head, I took a hands-on approach and participated in site visits to better understand field issues and needs. I will adopt the same hands-on approach as NESDI program manager. Like Leslie before me, I want to ensure that we are connecting with our end users through the needs that we collect and the projects that we sponsor. I expect to be out in the field as often as I can to make sure that our "new start" and ongoing projects are properly focused, well executed, and eventually integrated into Navy operations.

Now that I have served over six months as NESDI program manager, I have a strong appreciation of NESDI's business practices. The program has been very well run and has a very strong foundation of successes. Although we have an excellent track record and excellent processes, this does not guarantee future success. Almost immediately upon becoming NESDI program manager there were attempts to cut the program by millions of dollars in FY16. Ultimately program funding was not cut due to the successful efforts of our colleagues at our resource sponsor—the Chief of Naval Operations Energy and Environmental Readiness Division (OPNAV N45). However, we need to remain vigilant and continue to invest wisely. We need to continue to optimize NESDI processes and ensure that our solutions address validated requirements and needs in a cost-effective manner. We continue to face challenging times, certainly the NESDI team is up for this challenge.

What's in Store for FY15

I have a number of things in mind for FY15 and beyond. In addition to the new projects that we will initiate next fiscal year, I also intend to further enhance our needs collection process by providing additional guidance on our priority investment areas. (For insights into those investment areas, see page 58 of this document.)

I will also continue to focus on accountability including requiring detailed management plans at the onset of each of our new projects, and monitoring the ongoing status of all of our active projects to ensure that project expenditures stay on track so that the program's obligation and expenditure benchmarks are met.

How You Can Participate

We need the most help to identify environmental requirements and implement the results of our various projects into the ongoing operations of the Fleet. So, whenever you can, find a way to use the technologies we demonstrate and the research that we sponsor. Specifically, you can participate in our process and play a vital role by doing any or all of the following:

1. Submitting and validating an environmental need.
2. Reviewing the technologies already under development.
3. Supporting the integration of our products in your organization or at your installation.
4. Serving as a Principal Investigator on one of our projects.
5. Providing a demonstration site for one of our projects.
6. Staying up-to-date on our program by visiting our web site (www.nesdi.navy.mil).

And we're always looking for ways to do things better and more efficiently. So if you've got some ideas for us, please contact me or the appropriate member of the TDWG.

I hope you find this Year in Review report useful in gaining the insights you need into the operation and success of our program in FY14.

Ken Kaempffe
ken.kaempffe@navy.mil

The Mission of the NESDI Program

The mission of the NESDI program is to provide solutions by demonstrating, validating, and integrating innovative technologies, processes and materials; and filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Fleet readiness. The program seeks to accomplish this mission through the evaluation of cost-effective technologies, processes, and materials and knowledge that enhance environmental readiness of naval shore activities and ensure they can be integrated into weapons system acquisition programs.

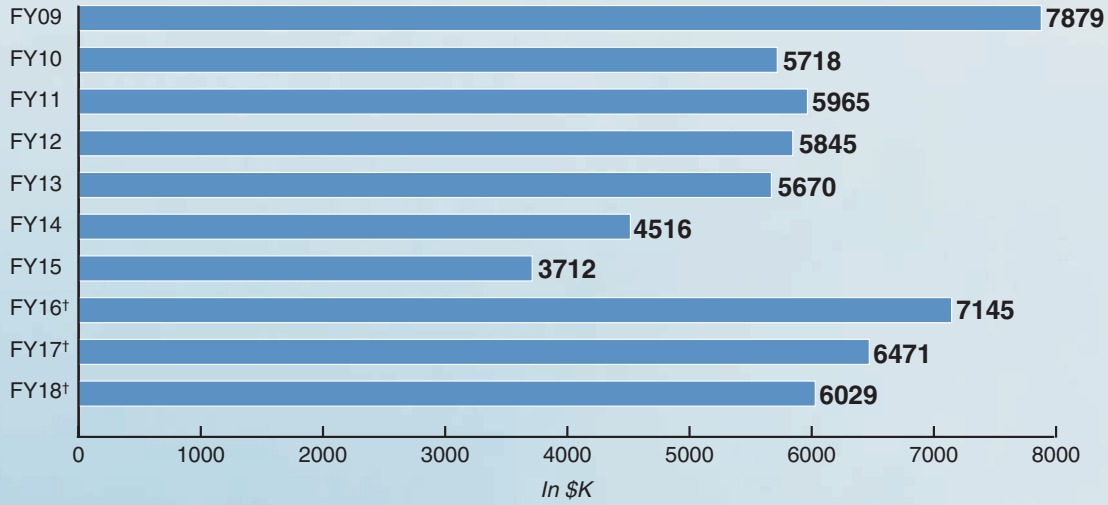
The NESDI program is the Navy's environmental shoreside 6.4 RDT&E program. The NESDI technology demonstration and validation program is sponsored by OPNAV N45 and managed by NAVFAC. The program is the Navy's complement to the Environmental Security Technology Certification Program (ESTCP) which demonstrates and validates technologies important to the tri-Services, U.S. Environmental Protection Agency (EPA), and the Department of Energy.

Financial Highlights

Program Funding

As always, the NESDI program establishes its investments based on the requirements identified by its end users in the Fleet and potential risk to the Navy mission. The following graphic summarizes program funding trends with actual amounts from FY09 to FY15 and projected amounts through FY18.

Program Funding Trends (FY09-FY18)

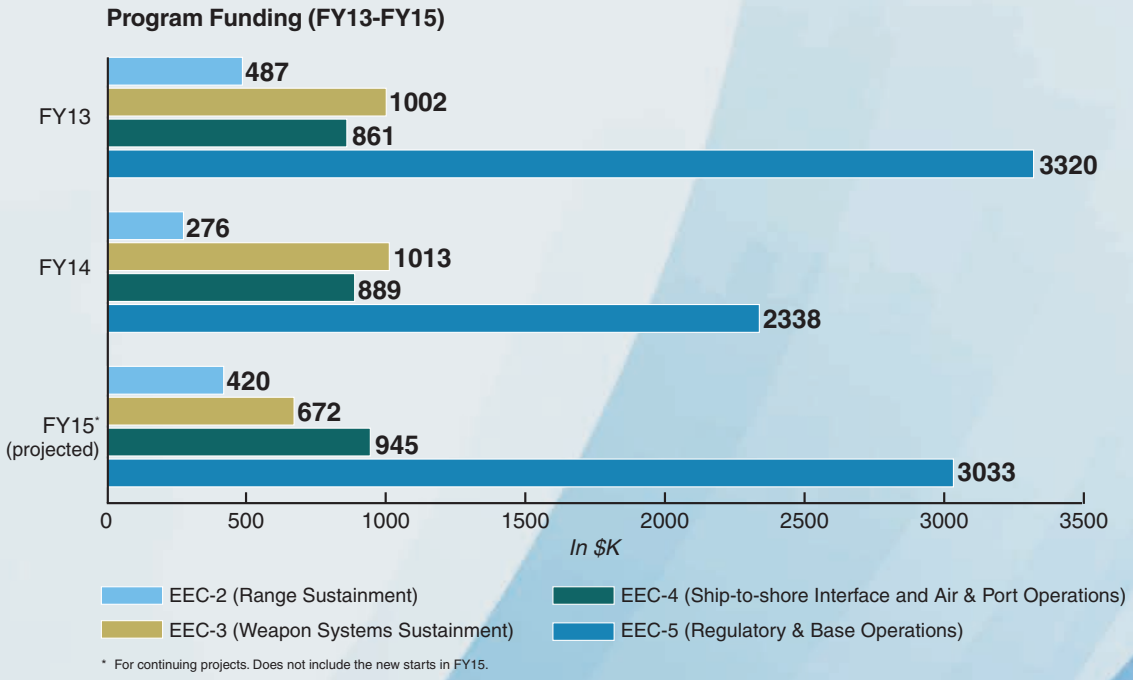


† Projected

One of 2014's project successes includes a modeling tool designed to quantify sources, loads, and mitigation actions for metals in stormwater runoff. Materials such as galvanized metal leach significant amounts of both copper and zinc. See page 51 for details.

Program Funding

The following graphic summarizes program funding trends by Environmental Enabling Capabilities (EEC). Details of the EECs are provided on page 58 and 59.



* For continuing projects. Does not include the new starts in FY15.

The project 348 team is demonstrating and validating pulsed electroplated nanocrystalline cobalt phosphorous alloy coatings as a replacement for the current hex chrome plating process. See page 21 for details.

The NESDI Program Process

The NESDI program executes the same four-phased process each year. This management process ensures the comprehensive collection of outstanding needs from the Fleet through the successful transition of workable solutions into the Navy's shoreside operating environment and its range at-sea testing and training activities. The four phases of that process are summarized below.

1. **Collect, Validate & Rank Needs.**
   During this first phase of the process, our management team—the Technology Development Working Group (TDWG)—solicits environmental needs from across the Navy's shore community. Once received, the TDWG then validates and ranks those needs based on a variety of criteria including whether the need falls within one of the program's priority investment areas, the pervasiveness of the problem across the Navy, the extent and severity of the associated compliance risk, and the potential impacts on the mission of the Fleet if the need isn't addressed.

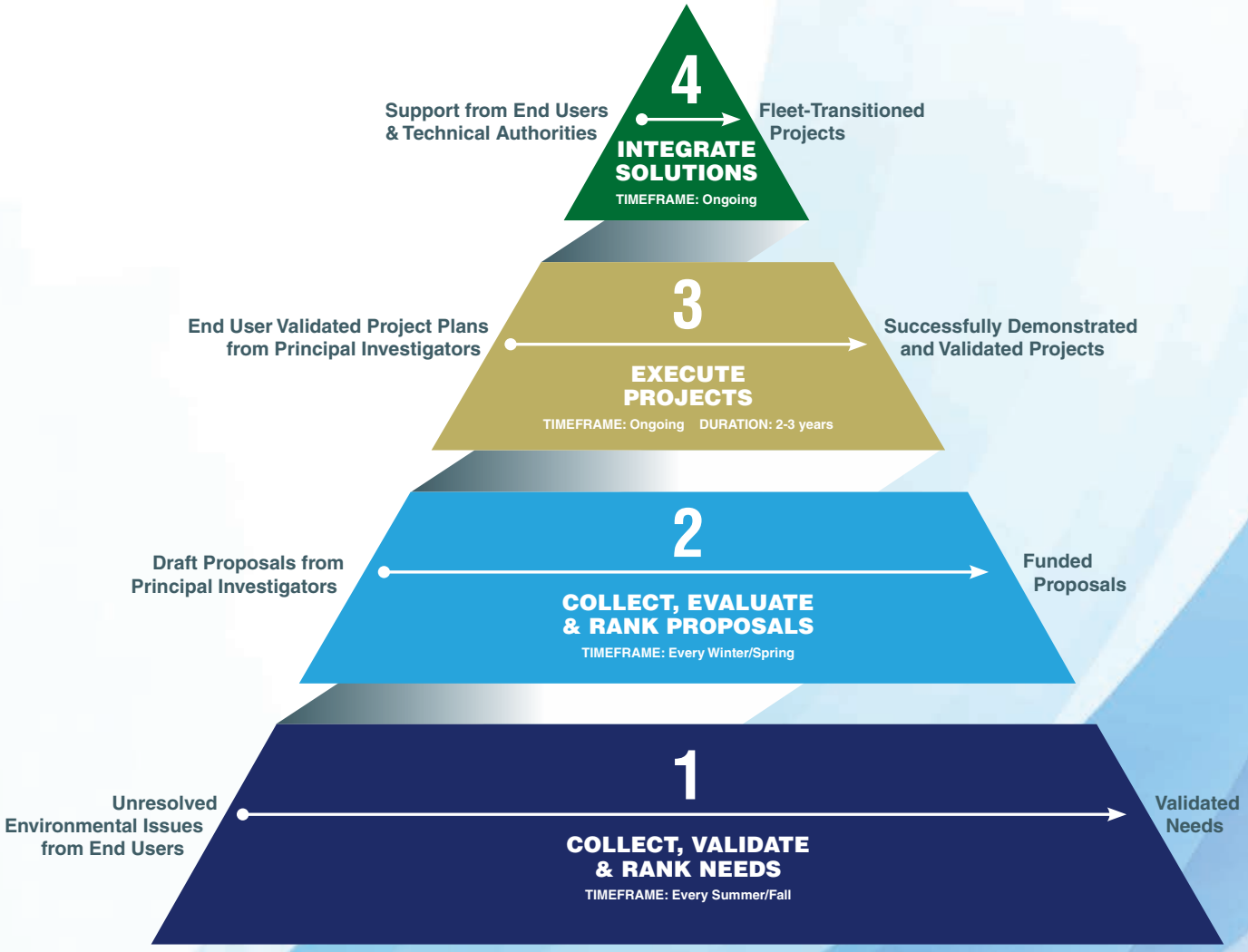
2. **Collect, Evaluate & Rank Proposals.**
   During this phase, the TDWG collects project proposals that address the needs collected in the first phase of the program process. In particular, the TDWG requests, collects, and reviews short pre-proposals and the subsequent detailed, full-length project proposals, and then recommends to the program's resource sponsor (OPNAV N45) which projects should receive program support.

3. **Execute Projects.**
   Once proposals have been selected and funded, the program—through initial planning, ongoing reporting and management oversight—ensures that the projects remain properly focused on the needs they were intending to address.

4. **Integrate Solutions.**
   Throughout the project lifecycle, we at NESDI concentrate on moving the demonstrated technologies and other solutions out of the laboratories and demonstration sites and into the appropriate operational environment. During this fourth and final phase of the NESDI program process, the TDWG, Principal Investigators and technology integration specialists work together to ensure that various solutions are successfully integrated into the Fleet and weapons system acquisition programs and verify that the solutions provide the anticipated benefits.

Throughout this process, the program's targeted customers—including need submitters, end users, technical authorities, and other stakeholders—provide valuable input to develop meaningful needs, support the ongoing execution of individual projects and help to ensure the successful integration of products and other solutions.

The inputs, outputs and timeframes associated with each of the above stages are highlighted in the following diagram. Outputs from each phase of this process as it was executed throughout FY14 are discussed in the following sections of this report.



The NESDI Program Process

The NESDI Program Process

1. Collect, Validate & Rank Needs

In this section of the FY14 NESDI Year in Review report, we discuss the process that was followed and the output that was generated through the execution of the first phase of our annual process—the collection, validation and ranking of needs, as in the previous illustration.

Process Overview

During this first phase of the process, the Technology Development Working Group (TDWG) solicits environmental needs from across the Navy's shore community. In addition to the program's formal needs solicitation process, this usually includes direct communication between TDWG members, end users, and environmental liaisons.

Once received, the TDWG then validates and ranks those needs based on a variety of criteria including whether the need falls within one of the program's priority investment areas, the pervasiveness of the problem across the Navy, the extent and severity of the associated compliance risk, and the potential impacts on the mission of the Fleet if the need isn't addressed.

Summary of Needs Collected, Validated & Ranked in FY14

For FY14, the NESDI program's needs collection process yielded 57 submittals from across the Navy. After a thorough review by program personnel, a solicitation for proposals was executed to address 17 needs determined to be priorities by personnel from the TDWG and our resource sponsor, the Chief of Naval Operations Energy and Environmental Readiness Division (OPNAV N45). Successful proposals will result in new projects beginning in FY15 and beyond.

Once needs were compiled, the TDWG met to consider all of the needs—determining whether a need was valid (within the scope of the NESDI program, not already being addressed by the program, etc.).

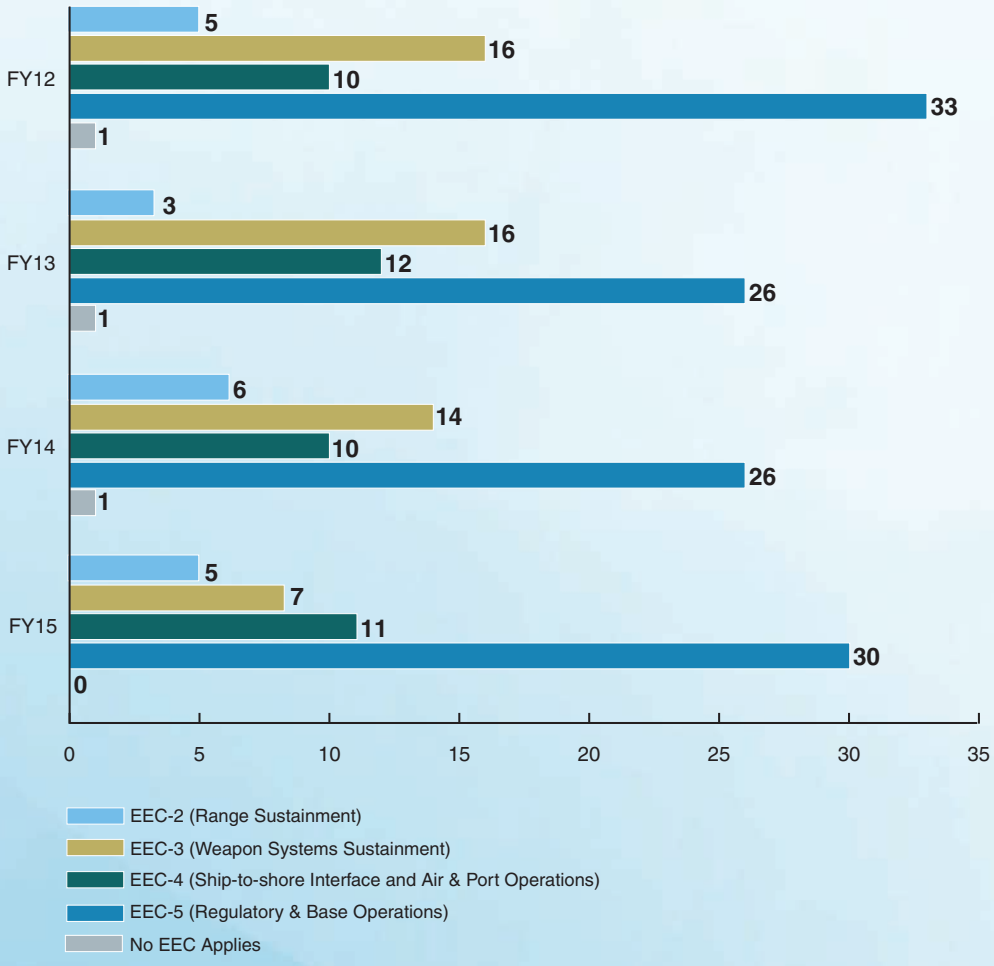
The TDWG then ranked those needs based on the program's investment priorities. Once the TDWG had completed its rankings, those preliminary rankings were passed along to the appropriate Subject Matter Experts (SME) at OPNAV N45. After a thorough review by the TDWG and approval by OPNAV N45 SMEs, the following 17 priority Fleet operational needs (with environmental solutions) were selected as the basis for new projects in FY15 and beyond.

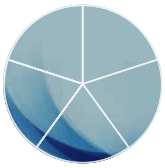
FY14 Validated Needs

No.	Need	EEC	Command	Title
1.	N-0914-14	5	NAVFAC	Flushing of Potable Water Distribution Lines to Maintain Chlorine Residual
2.	N-0925-14	5	NAVFAC	Web-Based Enterprise Hazardous Waste Database Application
3.	N-0937-14	3	NAVAIR	Leaking Thermosetting Elastomer Bomb Sealant in General Purpose Bombs
4.	N-0944-14	4	NAVFAC	Long-Term Integrated Sediment Management Strategy to Ensure Resiliency of Mission Critical Infrastructure
5.	N-0946-14	2	USFF	Multi-Spectral Weapon Impact Detection System
6.	N-0948-14	4	NAVSEA	Design Closed-Loop Cooling Water System to Accommodate Ships' Cooling Water Needs
7.	N-0951-14	4	NAVAIR	Environmental Effects Certification Protocol for Navy Tactical Fuels
8.	N-0952-14	3	NAVAIR	Trivalent Chromium Conversion Coating — Enhanced Coloration of Aluminum Substrates
9.	N-0953-14	5	Other	New Methods for Assessing Biological Response Metrics for Eutrophication Total Maximum Daily Loads
10.	N-0956-14	5	NAVFAC	In-Situ Discharge Monitoring
11.	N-0960-14	5	NAVFAC	How Building Characteristics Affect Vapor Intrusion Potential Into Industrial Buildings
12.	N-0961-14	5	NAVFAC	How Significant is Temporal Variability of Vapor Intrusion Data Associated with Industrial Buildings
13.	N-0965-14	5	NAVFAC	Perfluorochemicals on Naval Installations
14.	N-0970-14	3	NAVAIR	Corrosion Detection without Surface Coating Removal
15.	N-0978-14	4	NAVSEA	Drydock Effluent Filtration System
16.	N-0989-14	2	NAVFAC	Underwater Low Environmental Impact, Munitions Breaching Technology
17.	N-0990-14	5	NAVSEA	Develop an Automated Real-Time Opacity Monitor for Use in Determining the Opacity of Fugitive Emissions in lieu of EPA Method 9

FY12 – FY15 Needs Collected

Distribution of needs collected by the NESDI program has been relatively consistent for the past four years—most needs being collected in Regulatory & Base Operations (EEC-5).





Trendspotting:
FY12 – FY15 Needs Summarized

	2012	2013	2014	2015
Total Number of Needs Submitted	65	58	57	53
Number of Needs for Which Pre-proposals Requested	22	20	20	27
Percentage of Needs for Which Pre-proposals Requested	34	34	35	51
EEC 2: Range Sustainment	5	3	6	5
EEC 3: Weapons System Sustainment	16	16	14	7
EEC 4: Ship-to-shore Interface and Air & Port Operations	10	12	10	11
EEC 5: Regulatory & Base Operations	33	26	26	30
No EEC Applies	1	1	1	0
HIGH	2	4	1	4
MEDIUM	31	27	19	19
LOW	13	13	6	9

The NESDI Program Process

2. Collect, Evaluate & Rank Proposals

During this second phase of the NESDI program process, the TDWG collects project proposals that address the needs that were collected in the first phase of the program process. The program first requests, collects and reviews short (one to two pages) pre-proposals to ensure that the proposed project adequately addresses the subject requirements. We concentrate on technologies that are sufficiently mature for demonstration and validation, and support the overall environmental readiness of the Fleet and Navy acquisition communities.

Project 509 is addressing the need for a web-based enterprise application for the management of Navy's hazardous waste.

MC Specialist 2nd Class James R. Evans

Summary of Pre-proposals Requested & Received

In FY14, the NESDI program collected a total of 23 pre-proposals summarized in the table below:

No.	ID	Command	Title
1.	211	NAVSEA	Develop an Automated Real-Time Opacity Monitor for Use in Determining the Opacity of Fugitive Emissions in lieu of EPA Method 9
2.	210	NAVFAC	Design Closed-Loop Cooling Water SystemTo Accommodate Ship Cooling Water Needs
3.	209	SPAWAR	Initiation Decision Report for Perfluorochemicals
4.	208	NAVFAC	Multi-Sensor Weapons Impact Detection and Location System
5.	207	NAVFAC	Zero Discharge Inline Hydrostatic Flushing
6.	206	NAVSEA	Pierside In-Situ Discharge Monitoring for Collection and Holding Tank (CHT) Contaminants
7.	205	NAVFAC	Environmental Effects Certification Protocol for Navy Tactical Biofuels
8.	204	SPAWAR	Demonstration of an Improved Method for Quantifying Algal Biomass to Meet Nutrient Numeric Endpoint Compliance
9.	203	NAVFAC	New Methods for Assessing Biological Response Metrics for Eutrophication Total Maximum Daily Loads (TMDL)
10.	202	NAVFAC	Leaking Thermosetting Elastomer Bomb Sealant in General Purpose Bombs
11.	201	NAVFAC	Assessment of Indoor Air Volatile Organic Compounds (VOC) Temporal Variability and Influences of Building Characteristics for Navy Industrial Buildings Affected by Vapor Intrusion
12.	200	NAVFAC	Demonstration of Membrane Metal Treatment System for Compliance with National Pollutant Discharge Elimination System (NPDES) Discharge Permit Standards
13.	199	SPAWAR	Radiant Ship Cooling
14.	198	NAVFAC	Demonstration of Online Monitoring Technology to Improve Wastewater Plant Operation
15.	197	NAVAIR	Enhanced Trivalent Chromium Pretreatment for Improved Coloration and Corrosion Performance of Aluminum Substrates
16.	196	NAVSEA	Equipment and Process for More Effective Flushing of Potable Water Distribution Lines to Maintain Chlorine Residual Levels
17.	195	NAVAIR	Investigation of New or Improved Epi-Seal Materials
18.	194	SPAWAR	In Situ Discharge Monitoring and Alert System
19.	193	SPAWAR	Methods Evaluation to Minimize Water Flushing
20.	191	SPAWAR	Long-Term Integrated Sediment Management Strategy to Ensure Resiliency of Mission Critical Infrastructure
21.	190	SPAWAR	Environmental Effects Certification Protocol for Navy Tactical Fuels
22.	189	NAVFAC	Underwater Remotely Operated Vehicle Mounted Ultra-High Pressure Waterjet Cutter Tool for Underwater Munitions Breaching
23.	188	NAVFAC	Enterprise NAVFAC Hazardous Waste Application

Collect, Evaluate & Rank Proposals

If a pre-proposal is determined to be sufficiently focused on a viable solution to the targeted need, a more detailed, full proposal (three to five pages) is solicited from the Principal Investigator who submitted the pre-proposal. The full proposal defines quantifiable performance metrics to evaluate the ultimate success of the project and presents baseline data for later comparison to post-integration conditions.

Proposals that address the high priority needs and are judged to be well structured and feasible to implement receive the highest consideration.

Summary of Full Proposals Requested & Received

From the 23 pre-proposals submitted, we requested full proposals to address the following needs:

Pre-proposal Title & Number	Need to be Addressed
Enterprise NAVFAC Hazardous Waste Application (188)	N-0925-14
Underwater Remotely Operated Vehicle (ROV) Mounted Ultra-High Pressure (UHP) Water Jet Cutter Tool for Underwater Munitions Breaching (189)	N-0989-14
Long-Term Integrated Sediment Management Strategy to Ensure Resiliency of Mission Critical Infrastructure (191)	N-0944-14
• Investigation of New or Improved Epi-Seal Materials (195) • Leaking Thermosetting Elastomer Bomb Sealant in General Purpose Bombs (202)	N-0937-14
• Equipment and Process for More Effective Flushing of Potable Water Distribution Lines to Maintain Chlorine Residual Levels (196) • Zero Discharge Inline Hydrostatic Flushing (207)	N-0914-14
• Radiant Ship Cooling (199) • Design Closed-Loop Cooling Water System to Accommodate Ships' Cooling Water Needs (210)	N-0948-14
Assessment of Indoor Air VOC Temporal Variability and Influences of Building Characteristics for Navy Industrial Buildings Affected by Vapor Intrusion (201)	N-0961-14
• New Methods for Assessing Biological Response Metrics for Eutrophication TMDL (203) • Demonstration of an Improved Method for Quantifying Algal Biomass to Meet Nutrient Numeric Endpoint Compliance (204)	N-0953-14
Pierside In-situ Discharge Monitoring for CHT Contaminants (206)	N-0956-14
Multi-Sensor Weapons Impact Detection and Location System (208)	N-0946-14
Enhanced Trivalent Chromium Pretreatment (eTCP) for Improved Coloration and Corrosion Performance of Aluminum Substrates (197)	N-0952-14
Develop an Automated Real-Time Opacity Monitor for use in Determining the Opacity of Fugitive Emissions in lieu of EPA Method 9 (211)	N-0990-14

Summary of "New Start" Projects for FY14

We then turned our attention to reviewing the full proposals received. This review often involves communication with the proposal submitter if additional insights, details, and/or clarification are warranted. At the end of this review of full proposals, the TDWG generated a ranked list of recommended project "new starts" and sent it to OPNAV N45 for their final review and approval. The full proposal review process in FY14 resulted in the following 11 recommended project "new starts."

No.	ID	EEC	Title & Principal Investigator
1.	506	4	Compliance Options Study for NPDES for Cooling Water Intake Structures at Existing Facilities (PF Wang)
2.	507	4	Radiant Cooling for Closed-loop Water Containment (Dan Grady)
3.	508	2	Multi-Sensor Weapons Impact Detection and Location System (Joey Trotsky)
4.	509	5	Enterprise NAVFAC Hazardous Waste Application (Eric Friedl)
5.	510	5	Pierside In-situ Discharge Monitoring for Collection and Holding Tank Contaminants (Rachel Jacobs)
6.	511	5	Demonstration of an Improved Method for Quantifying Algal Biomass to Meet Nutrient Numeric Endpoint Compliance (Kara Sorenson)
7.	512	3	Investigation of Improved Epi-Seal Materials for Use in General Purpose Bombs (John Rettig)
8.	513	4	Design of Closed-Loop Cooling Water System to Accommodate Ship Cooling Water Needs (Sonny Maga)
9.	514	3	Enhanced Trivalent Chromium Pretreatment for Improved Coloration and Corrosion Performance of Aluminum Substrates (Peter Sheridan)
10.	515	2	Underwater Remotely Operated Vehicle (ROV) Mounted Ultra-High Pressure (UHP) Waterjet Cutter Tool for Underwater Munitions Breaching (Steve Hammett)
11.	516	5	Develop an Automated Real-time Opacity Monitor for Use in Determining the Opacity of Fugitive Emissions (Pat Morrow)

Highlights of these projects can be found starting on page 24 in this report.

One of this year's new start projects includes one devoted to improving Epi-Seal material for use in general purpose bombs. See page 38 for details.

The NESDI Program Process

3. Execute Projects

Once proposals have been selected and funded, the program—through initial planning, ongoing reporting and management oversight—ensures that the projects remain properly focused on the needs they were intending to address.

On the following pages, we highlight ongoing projects that have made a concerted effort to reduce hexavalent chromium and cadmium use, and provide a snapshot of 11 new start projects that are just getting off the ground.

Reducing Hexavalent Chromium & Cadmium: Five Projects Addressing Needs

One of the program's ongoing needs areas in the last few years has been the reduction of hexavalent chromium and cadmium use across the Navy.

Hexavalent chromium and cadmium are used in a variety of applications to protect Navy aircraft from corrosion. In 2009, the Office of the Secretary of Defense released a memo restricting the use of hexavalent chromium (Cr6+) unless no cost-effective alternatives with satisfactory performance were available. The use of cadmium faces similar restrictions. Personnel from NAVAIR, sponsored by the NESDI program, are working on five separate projects with the goal of eliminating the use of cadmium and hexavalent chromium on Navy and Marine Corps aircraft.

Demonstrating Advanced Non-Chromate Primers & Coatings (Project 458)

Hexavalent chromium (Cr6+) has been subjected to increased scrutiny and regulation from federal agencies, both domestic and foreign. Cr6+ has also become very expensive to use and dispose of due to its classification as a hazardous material. While minimum performance requirements have satisfied other Department of Defense (DoD) agencies, such as the U.S. Air Force and Army, the U.S. Navy's harsh operational environment demands maximum performance and therefore, further evaluation outside of qualification testing. A comprehensive demonstration and validation of mature non-chromate products is necessary to identify a product with corrosion performance that is equivalent to or better than the chromate coating systems fielded today.

This project has focused on the demonstration/validation of mature non-chromate primers throughout the Department of Defense.

This project, leveraged by ESTCP, has focused on the demonstration/validation of mature non-chromate primers throughout the DoD. The NESDI-sponsored portion of this effort focuses on Navy-specific products and processes. The project team's first task was to identify mature Class N primers (non-chromate based corrosion inhibitors) for extensive laboratory testing. Top performers were down-selected for accelerated corrosion tests. Initially, two products were selected for demonstration and validation: PPG-Deft 02-GN-084 (qualified to MIL-PRF-23377, Type I, Class N), and Hentzen 17176KEP (qualified to MIL-PRF-23377, Type II, Class N). These commercial-off-the-shelf primers were applied to the outer moldline (OML) on a minimum of two of each kind of aircraft at three different Fleet Readiness Centers (FRC). These aircraft include the H-46 Sea Knight helicopter, V-22 Osprey helicopter, H-53 Sea Stallion helicopter, T-6 Texan, T-34 Mentor, T-44 Pegasus, T-45 Goshawk trainer, E-2C Hawkeye fixed-wing aircraft, P-3 Orion surveillance aircraft, and F/A-18A-D Hornet.

The E-2C Hawkeye was one of the first aircraft to be treated with the new non-chromate primer demonstrated under project 458. MC Seaman Siobhana R. McEwen

The aircraft treated with non-chromate primers are being compared to analogous chromate-primed aircraft that are deployed at the same time and subjected to similar environments. Acceptable performance for full-scale demonstration and validation is two land-based aircraft completing at least two years of operational service, or two carrier deployments for aircraft that normally deploy on a carrier.

To date, the PPG-Deft 02-GN-084 primer has been successfully demonstrated on

the E-2C, P-3C, T-6, T-34, T-44, & T-45 aircraft. Service inspections done post-deployment documented good corrosion and adhesion performance. As a result, NAVAIR is drafting an authorization letter which specifies minimum performance of a product in an operational environment. NAVAIR will authorize PPG-Deft 02-GN-084 over chromate conversion coating on the OML of all Navy gloss paint scheme aircraft.

NAVAIR is currently evaluating Hentzen 17176KEP primer on the following aircraft: V-22, H-46, H-53, and F/A-18A-D. Unlike the gloss paint scheme aircraft, which are primarily aluminum on the OML, the OML tactical paint scheme of these aircraft is constructed of both composite and aluminum substrates. The H-53 and F/A-18A-D aircraft were painted in Fiscal Year 2014. Upon successful demonstration, NAVAIR anticipates authorizing the Type II primer for tactical aircraft.

Exploring Cadmium- and Hexavalent Chromium-free Electrical Connector Finishes (Project 451)

Electrical connectors are ubiquitous and essential components of aircraft and other vehicles at maintenance and repair facilities across the DoD. New finishes which contain neither cadmium nor hexavalent chromium have been added to the qualified products list for one common electrical connector specification: MIL-DTL-38999L. However, there has been no known Navy-relevant field testing of these products, meaning the corrosion risk is uncertain.

This project was initiated to perform Navy/Marine Corps field testing to determine relative performance of new and control plating classes.

This project was initiated to perform Navy/Marine Corps field testing to determine relative performance of new and control plating classes including MIL-DTL-38999L, Classes P, T, Z, M, W, J. Performance was quantified using both the real-world marine environment and the dynamic cycling of threaded circular connector. (Dynamic cycling refers to the opening and closing of connectors in the environment, which is more relevant than static corrosion testing because it incorporates corrosion and wear mechanisms on thread.)

At the end of a 12-month test, the cadmium plated aluminum (Class W) cadmium/Cr+6 controls and high-purity aluminum (Class P) finish appeared to be among the best performers (on aluminum body connectors); however, electrical assessments showed a surprising degree of variation among the various combined finishes tested. Composite connectors Class J and M also performed well.

Under project 451, field testing was conducted on two new connector finishes. Electrical connectors are found on all military aircraft. MC3 Bryan M. Ilyankoff

There have been significant development efforts by other organizations since this testing began in 2010, so the results of this work should be considered alongside these findings. The project's final report, available via the NESDI web site, cites these studies as well.

Project 328 is testing and authorizing a trivalent chromium process as a non-chromated replacement. Post-treatment coatings are used widely on landing gear for the AV-8B and other aircraft. MC3 Michael Achterling

Testing Non-chromated Post-treatments (Project 328)

Ion Vapor Deposition (IVD) of aluminum is a vacuum plating process which deposits pure aluminum on metal to enhance corrosion resistance. The IVD process itself is nontoxic; however, for a higher level of corrosion resistance, aircraft parts are typically subjected to a post-treatment process that includes chromated coatings (coatings containing Cr6+). Trivalent chromium is a less toxic alternative to Cr6+, and it was the goal of this project to test and authorize a trivalent chromium process as a non-chromated replacement.

It was the goal of this project to test and authorize a trivalent chromium process as a non-chromated replacement.

At the onset of this project, the trivalent chromium post treatment (TCP) had already been in use for five years as a pre-treatment for helicopter parts at FRC East in Cherry Point, North Carolina. This project team subjected TCP-treated parts to laboratory testing in 2009. After passing the tests, landing gear parts on two AV-8B aircraft were coated with the TCP at FRC East. After several years of service, there were no reported problems with corrosion or paint adhesion. NAVAIR approval is currently being sought for the treatment so that it can be used Navy-wide.

Validating Nanocrystalline Cobalt Phosphorous Electroplating as an Alternative to Hexavalent Chromium (Project 348)

Electrolytic hard chrome (EHC) plating is a technique that has been in commercial production for more than 50 years. It is used both for applying hard coatings to aircraft components in manufacturing operations and for general rebuild of worn or corroded components during overhaul. Chromium plating baths contain Cr6+. Because of this, plating operations must abide by EPA emissions standards and

Occupational Safety and Health Administration permissible exposure limits. During operation, chrome plating tanks emit a Cr6+ mist, which must be ducted away and removed by scrubbers. Additionally, wastes generated from plating operations must be disposed of as hazardous waste.

Nanocrystalline cobalt phosphorus (nCoP) alloy plating is an alternative electroplating process that uses pulse plating to create an ultra-fine nanocrystalline structure on top of the component part. The nCoP coating exhibits properties that are equivalent to and, in many ways, better than EHC deposits. This technology is a direct drop-in replacement for the existing EHC process and will only require modification of plating power supplies.

Significant reductions in energy consumption and increases in throughput can be achieved with the nCoP process. The overall plating efficiency of the nCoP process is greater than 90 percent, compared to less than 35 percent for EHC. This leads to significantly less hydrogen generation than the EHC process, minimizing the likelihood of hydrogen uptake and subsequent embrittlement of susceptible materials (i.e., high-strength steels). (Hydrogen embrittlement is the process by which various metals, most importantly high-strength steel, become brittle and fracture following exposure to hydrogen. Hydrogen embrittlement is often the result of unintentional introduction of hydrogen into susceptible metals during forming or finishing operations.) Unlike EHC, the nCoP process uses no constituents on the EPA list of hazardous materials and it does not generate hazardous emissions or by-products.

This project was formed to demonstrate and validate nanocrystalline cobalt phosphorus plating as an alternative to electrolytic hard chrome plating.

This project was formed to demonstrate and validate nCoP plating as an alternative to EHC plating. To achieve this, the team constructed two process tanks at FRC Southeast in Jacksonville, Florida. Various aircraft components were plated and tested using the nCoP process. In 2012, field testing was initiated on a T-45 Goshawk aircraft part. The part was removed for visual inspection after over 700 flight hours. It passed visual inspection and will be placed into another aircraft for continued service.

Underway at present is field testing of nCoP-coated lifting pins in aircraft-handling equipment aboard an aircraft carrier and nCoP-coated hydraulic cylinders on a Marine Corps Earthmover vehicle.

When testing is complete, this technology is expected to be transitioned to all FRCs, leading to lower health and environmental risks, and reduced lifecycle costs due to superior performance.

The project 348 team is demonstrating and validating pulsed electroplated nCoP alloy coatings as a replacement for the current hex chrome plating process used on components for the T-45 and other military aircraft. MC3 Nathan Parde

Validating a Zinc-Nickel Alternative to Cadmium Tank Electroplating (Project 450)

Cadmium is targeted by the EPA and is also included in NAVAIR's FRC Toxic Metal Control Program, which requires that it be replaced with available alternative technology. Like hexavalent chromium, cadmium has historically been used as a corrosion inhibitor. It is applied to ferrous, aluminum, and copper alloys (via electroplating and other methods) to protect them from corrosion due to contact with dissimilar metals. Besides having excellent corrosion resistant properties, cadmium offers natural lubricity where torque requirements are needed. Cadmium electroplating is used on weapon systems throughout the DoD.

This project is demonstrating and validating an improved alkaline zinc-nickel alloy plating process, and will validate a trivalent chrome post-treatment for use with the demonstrated process.

Many alternatives to cadmium tank electroplating have been addressed, but with limited success due to performance drawbacks and/or process limitations as a direct drop-in replacement. For example, earlier formulations of zinc-nickel (Zn-Ni) alloy plating were susceptible to hydrogen embrittlement. Because of this danger, a nickel pre-plate step was added to the process. However, this method still resulted in inferior fatigue performance, which limited the process to use with non-critical structures.

This project is demonstrating and validating an improved alkaline Zn-Ni alloy plating process, and will validate a trivalent chrome post-treatment for use with the demonstrated process. The Zn-Ni alloy tank plating process (known as DIPSOL IZ-C17+) offers equivalent performance characteristics as current methods, but with reduced hazardous waste treatment and associated environmental/medical monitoring costs. It also requires minimal capital investment and impact to production, as existing cadmium tanks can be lined and filled with Zn-Ni solution. This process meets the requirements for a non-embrittling process per American Society for Testing and Materials (ASTM) standards. Currently, ASTM testing for corrosion is underway at FRC Southeast. If field testing is successful, DIPSOL IZ-C17+ will be an immediate drop-in replacement for cadmium tank electroplating.

The alternative electroplating process demonstrated and validated under project 450 is used on high-strength steel components found on aircraft such as the F/A-18 series shown here. MC Specialist 2nd Class Timothy A. Hazel

For more information on any of the previous projects, visit www.nesdi.navy.mil then select "Current Projects" and search by project number or keyword.

A Snapshot of FY14 "New Starts"

There were 11 new start projects in FY14, tackling the issues of ship wastewater and cooling water discharges, a safer approach to underwater munitions breaching, a new method for weapons impact detection, and more.

1. **Compliance Options Study for NPDES for Cooling Water Intake Structures at Existing Facilities (project 506)**

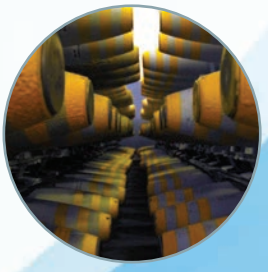
2. **Radiant Cooling for Closed-loop Water Containment (project 507)**

3. **Multi-Sensor Weapons Impact Detection and Location System (project 508)**

4. Enterprise NAVFAC Hazardous Waste Application (project 509)

5. Pierside In-Situ Discharge Monitoring for Collection and Holding Tank Contaminants (project 510)

6. Demonstration of an Improved Method for Quantifying Algal Biomass to Meet Nutrient Numeric Endpoint Compliance (project 511)



7. Investigation of Improved Epi-Seal Materials for Use in General Purpose Bombs (project 512)

8. Design Closed-loop Cooling Water System to Accommodate Ship Cooling Water Needs (project 513)

9. Enhanced Trivalent Chromium Pretreatment (eTCP) for Improved Coloration and Corrosion Performance of Aluminum Substrates (project 514)

10. Underwater ROV Mounted UHP Waterjet Cutter Tool for Underwater Munitions Breaching (project 515)

11. Develop an Automated Real-time Opacity Monitor for Use in Determining the Opacity of Fugitive Emissions (project 516)

Read on for more details on each of these newly funded projects. To keep up to date on these and all NESDI projects as the year progresses, visit www.nesdi.navy.mil, select "Current Projects," and search by project number or keyword.

Project No. 506

Compliance Options Study for NPDES for Cooling Water Intake Structures at Existing Facilities

Reducing Vessel Cooling Water Intake

Investigating Options to Comply with Flow Rate Reductions in Proposed EPA Rule

Across the world, many industrial facilities and power plants depend on a large supply of cooling water from near-shore environments to keep processes running smoothly. Shipyards also require massive amounts of cooling water, particularly when a ship is in dry dock. A large ship requires a constant supply of cooling water to pass through its heat exchangers and equipment in order to keep it functioning properly.

However, the intake of water for vessel cooling at these volumes and rates has the potential to entrain and impinge large numbers of fish, fish eggs and larvae. A new rule promulgated by the U.S. Environmental Protection Agency (EPA) is poised to affect cooling water intake structures at all Navy facilities that take in over two million gallons of water per day—in other words, all Navy shipyards. The rule requires that intake structures

The intake of water for vessel cooling at these volumes and rates has the potential to entrain and impinge large numbers of fish, fish eggs and larvae.

Submarine arriving at Joint Base Pearl Harbor-Hickam.
This is one of the shipyards that will be affected by the new EPA rule.
MC Specialist 2nd Class Ronald Gutridge

be designed and operated such that flow rates through the intake screen holes are less than half a foot per second. This rule, which became effective 14 October 2014, enforces through each facility's National Pollutant Discharge Elimination System (NPDES) permit. The EPA will set compliance deadlines on a case-by-case basis.

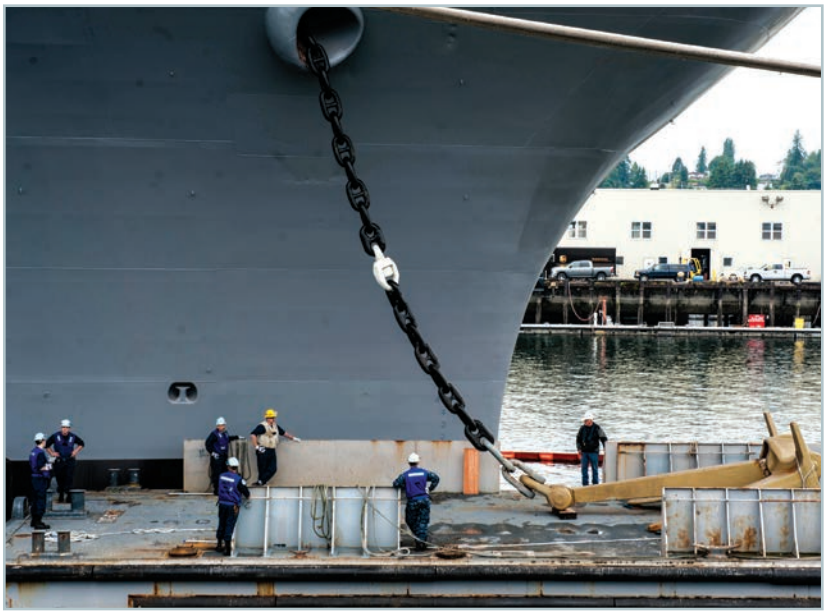
This project team, led by Pei Fang Wang of the Space and Naval Warfare Systems Command Systems Center Pacific, was formed to evaluate and determine compliance options for shipyards. First, the team is reviewing and evaluating existing cooling water intake systems at five Navy sites that will be impacted by the new EPA rule. Tentatively, these five sites are:

1. Norfolk Naval Base, VA
2. Portsmouth Naval Shipyard, ME
3. Pearl Harbor Naval Shipyard, HI
4. Puget Sound Naval Shipyard, WA
5. Naval Base Kitsap Bangor, WA

The team will study the design and operation of each facility's system, current flow, existing impingement or entrainment prevention measures, and the options for meeting compliance standards.

The team will first determine whether each facility is out of compliance at the present time, and if so, whether minor modifications to the existing system could be undertaken. To determine this, state-of-the-science mathematical models will be used and verified.

If minor modifications of the existing intake system still cannot meet the compliance requirements of the new rule, the team will work with the regulators to consider alternative measures, such as a moving screen with fish return device, coupled with the intake modification.



A ship arrives at Puget Sound Naval Shipyard and Intermediate Maintenance Facility. This is one of the shipyards that will be affected by the new EPA rule.

MC Specialist Seaman Apprentice Christopher Frost

If both of the above two options fail to meet the compliance requirements of the new rule, the team will explore new designs and proceed with implementation of the selected intake systems. Throughout the project, the use of high-fidelity, data-validated numerical models will provide accurate predictions which can be used to evaluate various compliance options.

Throughout the project, the use of high-fidelity, data-validated numerical models will provide accurate predictions.

The scientific data and technically defensible methods/products developed during this project will allow for modification or redesign of each facility's existing intake system to meet compliance requirements of the new EPA rule. The potential compliance options provided during the course of the project can be applied to all Navy facilities.

Project deliverables include the following:

1. Results of the team's review and evaluation of existing cooling water systems
2. Options for modification of the existing intake systems or implementation of new designs
3. An engineering analysis of the existing and potential future water intake systems with performance criteria
4. Recommendations for compliance to the new rule.

Pei-Fang Wang, Space and Naval Warfare Systems Command, 619-553-9192, pei-fang.wang@navy.mil

Project No. 507

Radiant Cooling for Closed-loop Water Containment

Closing the Loop

A New Idea for Eliminating Cooling Water Discharge

To avoid overheating and malfunctioning, a ship's engines and machineries require a constant supply of cooling water. In most cases, this water is passed through the ship's systems and discharged into the open ocean. This discharge water contains a relatively high concentration of copper and other metals, and is at a higher temperature compared to ambient conditions. This is not a concern at sea, but when a ship is in dry dock, some of its systems remain active, necessitating the use (and discharge) of cooling water—water that has the potential for exceeding environmental regulations.

A closed-loop water cooling system would eliminate the discharge of any cooling water back into the harbor and thereby satisfy regulatory requirements.

Regulations regarding metal contaminants and discharge water temp-

Even in dry dock, some ship components continue to operate normally and require cooling water.

MC Specialist Seaman Apprentice Patrick Dionne.

erature will become stricter in the short to medium term, and this will require a change in current practice. A closed-loop water cooling system would eliminate the discharge of any cooling water back into the harbor and thereby satisfy regulatory requirements. However, designing a closed loop system for a large ship based on conventional refrigeration technology or above-ground cooling towers would require a prohibitively large physical footprint and high operating costs.

To address this challenge, a project team from the Space and Naval Warfare Systems Command, Systems Center Pacific is proposing a novel reversal of commercial technology widely used in home and office buildings: radiant floor heating. In a radiant heating system, water is heated in a boiler and pumped through a series of pipes embedded in the floor or walls of an indoor space; from there, it radiates into the air.

Using these principals, the project team is studying the feasibility of embedding pipes underground and using the ground as a heat reservoir to cool effluent cooling water from ships in dry dock. This approach has clear advantages for the Navy problem. As a closed-loop system, it eliminates any concern about violating regulations on the contents or temperature of effluent water returned to the bay. Such a system could even provide an additional advantage: water passing through the system could be hyper-chlorinated to help clean biofouling in ship systems. And unlike solutions that involve a refrigeration plant or cooling towers, this system would have an exceptionally small physical footprint—since only pumps need be above ground—and low operating costs, since all cooling is passive and water does not need to be pumped uphill.

Water passing through the system could be hyper-chlorinated to help clean biofouling in ship systems.

PSNS&IMF would be an ideal first customer for this technology. MC Specialist 2nd Class Ryan J. Mayes

While radiant heating is a mature technology, no one has ever explored its use on a scale that could accommodate millions of gallons of water a day. Therefore, it is the goal of this project to produce an Initiation Decision Report to determine whether this system is a reasonable option.

The report will examine what materials would be feasible for closed-loop cooling, and the cost trade-offs between them. In order to help determine layout requirements, the team will devise a simple first-order model to determine how the required water flow, length and thermal conductivity of pipe, and ambient ground temperature are related to each other.

Puget Sound Naval Shipyard & Intermediate Maintenance Facility (PSNS&IMF) would be an ideal first customer for this technology, as it is located in a cooler climate and pipes could be buried at a relatively shallow depth. The final report will include input from PSNS&IMF stakeholders and will outline a small-scale demonstration system that could be built at this location.

Of all potential closed-loop designs, the passive radiant cooling system proposed by this project team has the distinct advantages of an extremely small physical footprint, since the majority of the system aside from pumps would be buried, a very low operating cost, since the only energy that's required goes to circulating water at an essentially constant height, and an added benefit of pushing hyper-chlorinated water back into the ship's system.

Daniel Grady, Space and Naval Warfare Systems Command, 619-553-2793, daniel.grady@navy.mil

Project No. 508

Multi-Sensor Weapons Impact Detection and Location System

Tracking Off-target Ordnance

Seismic-acoustic Technology Senses Weapons Impact

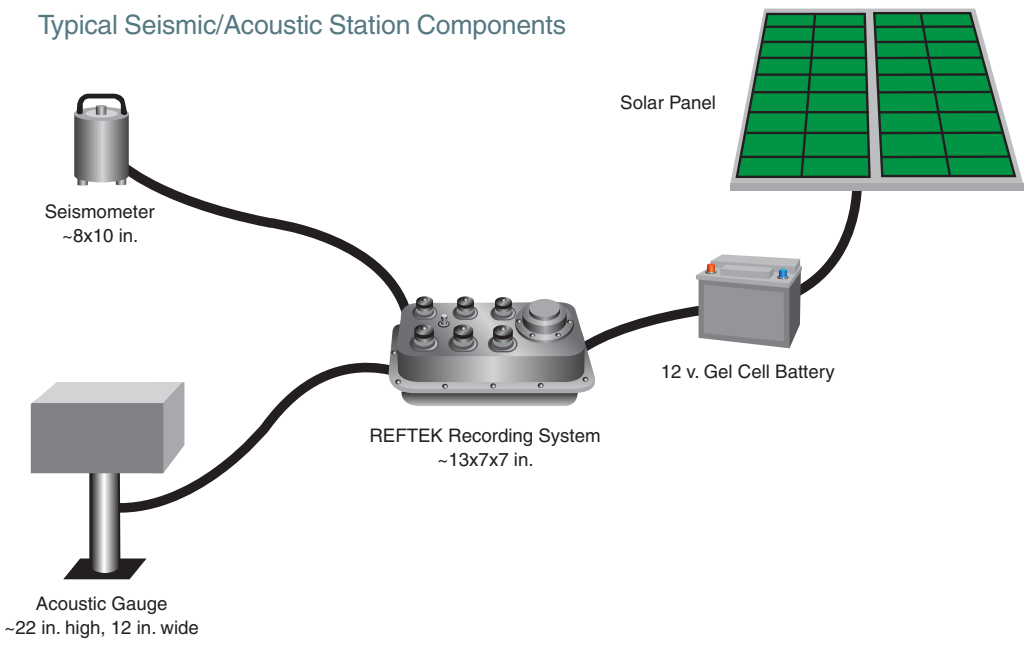
Naval Air Station Fallon and Fallon Range Training Complex (FRTC) are the Navy's premier integrated strike warfare training facilities. Thousands of weapons are dropped or spent annually across four geographically separated bombing ranges and 553 target aim points covering potentially hundreds of square miles of high desert in northern Nevada. Although weapon impacts off-range/off-target seldom occur, they can significantly threaten public safety and sustainability of the range. For ranges that are on or near public lands, the Navy is required to locate and remove any ordnance that inadvertently lands off-range. Currently, an electro-optical training system known as the Weapon Impact Scoring System (WISS) provides video imagery of impacts. This system is designed to measure the accuracy of the impact with respect to the target center, but cameras have a very limited field of vision. There is currently no method to locate weapons impacts that may have traveled off range except through a labor-intensive visual search of a large area.

Seismic-acoustic sensor technology senses both the impact shock of the weapon through the ground strata (seismic) and the sound wave propagation through the air (acoustic). This technology can help pinpoint the location of weapons impact by determining arrival time differences between the acoustic phase and seismic arrivals, assuming there is some knowledge of the effective propagation speeds through air and the ground.

This technology can help pinpoint the location of weapons impact by determining arrival time differences between the acoustic phase and seismic arrivals.

An F/A-18A Hornet drops two inert general purpose bombs.

Photographer's Mate Airman Kristopher Wilson



Seismic-acoustic sensors are a mature technology that is used on a larger scale for nuclear testing treaty monitoring purposes. The Defense Threat Reduction Agency (DTRA) has used temporary seismic and acoustic networks for almost two decades to provide detonation information as well as weapon performance diagnostics on a variety of air-delivered weapons tests.

In 2012, a seismic-acoustic system was tested for small scale use on an FRTC range. The main objective of this array was to determine precise time on target of each weapon; 12 geophones were positioned in close proximity to each of the targets. In order to determine the location of any off-target weapons, two more sensitive seismic-acoustic stations were placed at some distance from the targets. Two weapons impacted significantly off target during the 2012 exercise. The seismic array produced a very rough estimate of the location of one of these weapons.

This project team plans to install a larger array with sufficient redundancy to detect off-range/off-target impacts. A one-week demonstration will be conducted at FRTC range B-17 impact areas to take advantage of the large number and diversity of targets and weapons employed on this range. The demonstration will be conducted using the same system employed by DTRA but will consist of a larger network with up to 48 individual sensor packages distributed over six to eight stations. A wide variety of weapons will be employed against various targets. Triangulation of sensor data utilizing existing algorithms will geo-locate weapon impacts. For evaluation, onsite visual spotting and WISS will be used to verify weapons impact points and crosschecked with seismic-acoustic system output.

Accurate accounting of each weapons impact will help to limit time and resources currently spent on manual range searches.

For the demonstration to be deemed successful the system should be able to detect 500-pound inert practice bombs (smaller sources may be detectable at close ranges depending on the sensor density and local background noise conditions).

Accurate accounting of each weapons impact will help to limit time and resources currently spent on manual range searches. This has the potential to reduce range closure periods and improve range availability.

A final technical report will be prepared at the conclusion of the demonstration and distributed to Navy operational commands and range managers. It is expected that a successful demonstration at FRTC's B-17 range, with its difficult geographical mass composition will enable subsequent implementation throughout other Navy bombing ranges.

Joey Trotsky, Naval Facilities Engineering and Expeditionary Warfare Center, 805-982-1258, joey.trotsky@navy.mil

Project No. 509

Enterprise NAVFAC Hazardous Waste Application

Developing an Enterprise-wide Hazardous Waste Management System

New Initiative Leverages Existing Programs & Software

Currently, ten Naval Facilities Engineering Command (NAVFAC) component commands manage the majority of hazardous waste generated by ship and shore operations at roughly 90 percent of Navy installations. These regional facilities engineering commands (FEC) and their installations utilize numerous 'homegrown' management tools ranging from paper and pen to spreadsheets to relational databases, with varying degrees of success. For many years there has been a need for a common web-based application that could be used by NAVFAC FECs worldwide to enable consistent reporting, waste tracking, manifesting, and ultimate disposal of hazardous waste on a single Information Technology platform.

To meet this need, personnel from the NAVFAC Engineering and Expeditionary Warfare Center (EXWC) are developing an enterprise system (large-scale application package) for hazardous waste tracking.

This new application will most likely become a new module within EMSWeb.

EXWC has previous experience designing, populating, and supporting structurally similar internet-based applications and databases; most significantly the Environmental Management System Web (EMSWeb). The project team will leverage some

Fireman Joel Prentiss secures barrels of hazardous waste in heavy plastic aboard USS Harry S. Truman (CVN 75) for transport and proper disposal. MC Specialist 3rd Class Stuart B. Phillips

of the features and functionality (including design concepts, programming code, and lessons learned) of EMSWeb for the enterprise hazardous waste application.

In a related effort, NAVFAC headquarters is demonstrating the adaptation of the NAVFAC Environmental Waste Application—currently used in Hawaii—at two NAVFAC Northwest installations. Where possible, the EXWC team will harness the features and functionality of this tracking tool developed by NAVFAC Hawaii.

The project team will define and translate the system requirements to a programming contractor who will build the enterprise tool framework. It is envisioned that this application will most likely become a new module within EMSWeb, hosted on the Navy's environmental website—the Environmental Program Requirements portal.

A prototype of the tool will be fielded at several candidate test sites for a trial test period. Test participants will utilize the new tool alongside the current/status quo approach. Feedback from the trial test period will be collected, improvements will be incorporated into the final database tool, and the enterprise hazardous waste application will be released so that Navy hazardous waste program managers and technicians may begin to access and utilize the new application in real-time. User training (including a user's guide, web training, and live support) will be designed for the rollout and initial support for the newly fielded application.

This standardized database application will facilitate a consistent approach to hazardous waste management across the enterprise in the form of cost accountability, business practices, and operational and regulatory reporting. For instance, once implemented, it will be possible to rapidly assess hazardous waste costs borne by the Navy for specific types of waste, or for all hazardous waste. Currently, obtaining this insight requires lengthy data calls involving data extraction and manipulation from numerous disparate sources, ultimately yielding only approximate estimates. Additional benefits involve reduced labor and burden associated with completion of annual and biennial reporting requirements.

Aviation Structural Mechanic Airman Erickson Schafer bands barrels of hazardous waste for offload to a Military Sealift Command ship.

MC Specialist 2nd Class James R. Evans

Once implemented, it will be possible to rapidly assess hazardous waste costs borne by the Navy for specific types of waste.

The new hazardous waste application will afford the Navy, NAVFAC component commands, and individual installations worldwide the analytical insight and tools they need to better manage and track the waste they generate, thereby improving compliance and reducing the potential for violations.

Eric Friedl, Naval Facilities Engineering and Expeditionary Warfare Center, 805-982-3688, eric.friedl@navy.mil

Project No. 510

Pierside In-Situ Discharge Monitoring for Collection and Holding Tank Contaminants

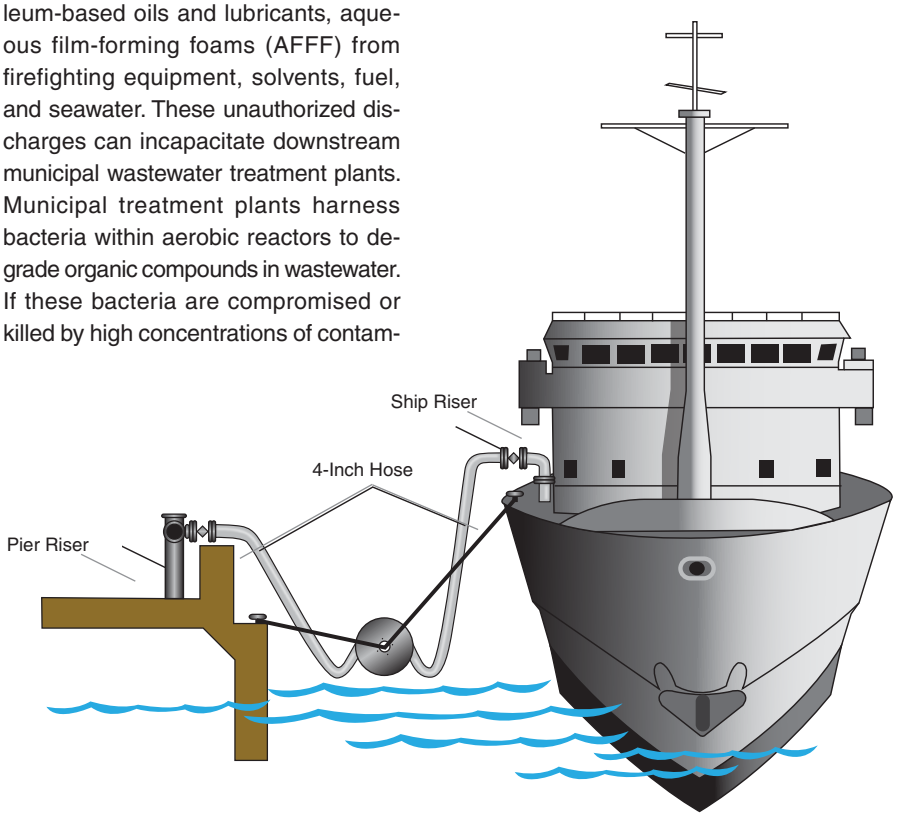
Pierside Monitoring System Targets Unauthorized Discharge Water

Sensors Identify Harmful Constituents

When a ship is underway, all wastewater utilized during normal daily activity is collected into collection and holding tanks (CHT). After docking, Navy ships pump the contents of their CHTs into pierside risers which lead to the local municipal wastewater treatment plant. The liquid held in the ship's CHT is generally a combination of graywater (freshwater from sinks, showers, laundry, and galley) and blackwater (sewage). Consequently, this wastewater should only contain a mixture of detergents, soaps, food particles, and other organic material; all of which is readily biodegradable and acceptable for municipal treatment.

CHT discharges sometimes contain undesirable constituents such as petroleum-based oils and lubricants, aqueous film-forming foams (AFFF) from firefighting equipment, solvents, fuel, and seawater. These unauthorized discharges can incapacitate downstream municipal wastewater treatment plants. Municipal treatment plants harness bacteria within aerobic reactors to degrade organic compounds in wastewater. If these bacteria are compromised or killed by high concentrations of contaminants that are toxic or not readily biodegradable, the treatment plants are unable to clean water to required standards. Restoration times for disrupted biological tanks can extend from days to weeks depending on the degree of biomass die-off. Consequently, there is a strong need to be able to identify when high concentrations of potentially damaging constituents are present in wastewater before it reaches the local wastewater treatment plant.

Contaminants can disrupt the biological reactors used in municipal wastewater treatment.



Schematic diagram of the wastewater disposal system.

The treatment plant at Naval Station Mayport is a Navy-owned asset, subject to additional constraints, such as limited capacity and a desire to utilize byproduct sludge for beneficial use (which requires more stringent adherence to standards). Offloading of CHT wastewater that contains these toxic contaminants violates the station's permit conditions. It is not currently possible for Mayport's Public Works Department (PWD) to identify which specific ship(s) may be discharging these damaging constituents into a communal riser. Ship personnel present at the time of discharge may also be unaware of such constituents within their CHTs, and therefore cannot assist the PWD in isolating problematic discharges.

This project was initiated in order to help a PWD quickly identify when and where a problem discharge occurs before damage is incurred by a treatment plant. The project team is developing, configuring and demonstrating commercial off-the-shelf sensor technology to determine the presence of materials such as oil, foam, and seawater. There are multiple sensor technologies currently available for the detection of each individual constituent, all of which can provide feedback in less than five minutes. To cover all potential contaminants, an integrated array of sensors will be used.

The sensor package will be validated at Naval Surface Warfare Center, Carderock Division's wastewater treatment laboratory. Tanks will be assembled with various concentrations of delivered wastewater, bulk oil, saltwater, and concentrated detergent. Tests will occur at various flow rates to determine if high spikes of undesirable constituents will foul the sensor array. Additional tests to determine sensor recovery after cleaning will also occur during this validation period. The array will be considered successful if it can consistently detect high levels of oils, foam, and salt within a five minute time period; not give false negatives if combinations of oils, foam, and salt are present; and does not give false positives after cleaning.

Sailors aboard the Arleigh Burke-class guided-missile destroyer USS Porter (DDG 78) disconnect the CHT system from shore drainage while preparing to get underway. MC Specialist 3rd Class Scott Pittman

After laboratory validation, the in-situ monitor package will be demonstrated at a pier riser at Naval Station Mayport. In order to provide sampling liquid to the sensor array, a slipstream will be pulled off the main pumping line via a connector at the riser. An out-of-compliance signal from any sensor will initiate a signal to cease pumping operations.

Once these sensors are installed at each ship's pier riser connection point, the PWD should be able to identify the ship or ships that are discharging problem constituents.

The unit will be constructed to be as portable as possible, and require minimum resources for operation. Data collected by the unit will be retrievable either by removable storage device, USB port to portable personnel device, or cellular reporting can be provided.

It is anticipated that once these sensors are installed at each ship's pier riser connection point, the PWD should be able to identify the ship or ships that are discharging problem constituents. Once identified, PWD has the option of disconnecting the ship from the communal riser until either its CHT contents can be offloaded separately, or until an agreed-upon plan is established to dilute the problem constituents with fresh water to ensure the influent will not acutely damage the biological tanks at the facility.

While this technology was designed specifically to help Mayport's PWD avoid potential permit violations and fines, it may also be used at any naval facility where multiple ships offload to a common riser.

Rachel Jacobs, Naval Surface Warfare Center, Carderock Division, 301-227-5233, rachel.jacobs@navy.mil

Project No. 511

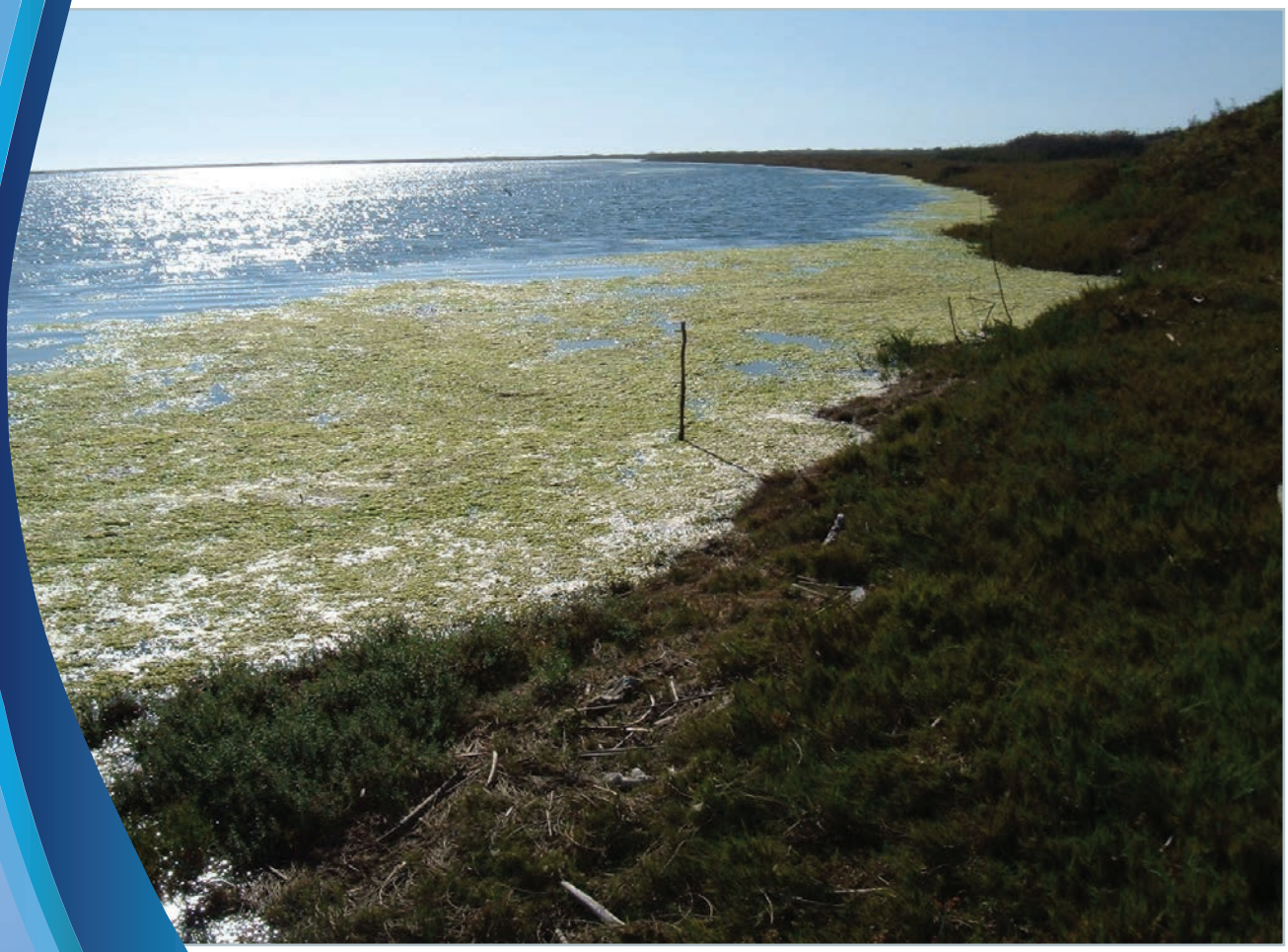
Demonstration of an Improved Method for Quantifying Algal Biomass to Meet Nutrient Numeric Endpoint Compliance

Tackling Nutrients in Navy Waters

Considering Algal Biomass As an Impairment Metric

Nutrients and algae are naturally present in the aquatic system and are necessary for proper function of biological communities, but an excess of nutrients, particularly nitrogen and phosphorus, can cause algae to grow faster than an ecosystem can handle. This can lead to deleterious biological responses in surface waters. This condition, termed eutrophication, has the potential to impact habitat quality through loss of seagrass and kelp beds, smothering of benthic (bottom dwelling) organisms, nuisance odors, and fish mortality. The Navy's Total Maximum Daily Load (TMDL) prioritization report lists nutrients as one of the top five pollutants impacting water quality at Navy installations.

The Navy's TMDL prioritization report lists nutrients as one of the top five pollutants impacting water quality at Navy installations.



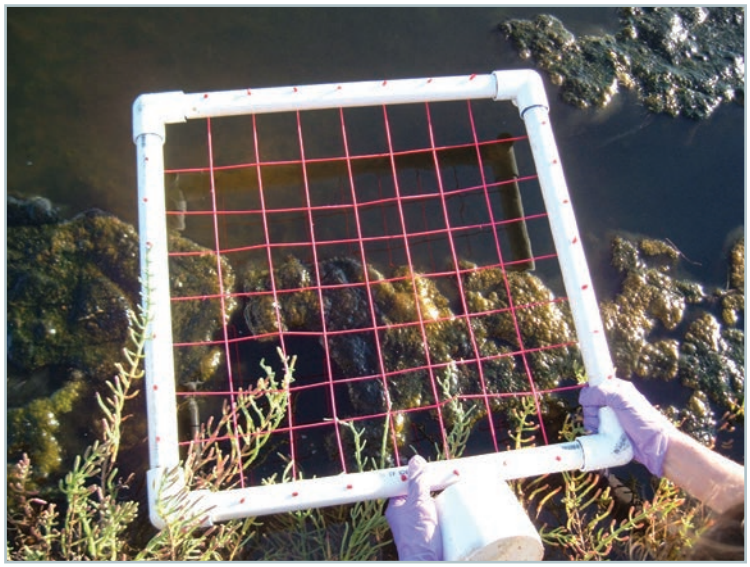
Example of algal overgrowth. Kara Sorensen

Traditionally, measurements of eutrophication have focused on the level of nutrients present or entering into the system. More recently, the U.S. Environmental Protection Agency and many state and European regulators are moving to the use of biological response such as algal cover, algal biomass, and dissolved oxygen as a measure of impairment. This approach is termed Nutrient Numeric Endpoints (NNE). In the near future, the focus for compliance is likely to move away from metrics like nitrogen and phosphorous and move toward NNE metrics.

This project was formed to identify new, cost-effective methods for undertaking NNE metrics.

Algal biomass includes both planktonic (floating) algae and benthic macroalgae. Current protocols for monitoring planktonic algae in water samples are well developed and are applied routinely for all types of water bodies. However, for water bodies where benthic macroalgae is predominate, the protocols are not as well developed. In these instances the protocol calls for collecting a limited number of samples in the intertidal zone (the area that becomes exposed at low tide) and applying the results to the entire waterbody. As a result large portions of the waterbody, in particular the subtidal areas, go unmeasured. These protocols are therefore not well validated for quantifying the true level of algal biomass for a given waterbody.

The project team from the Space and Naval Warfare Systems Command, Systems Center Pacific, will evaluate current techniques being used in this arena for other applications. Two of the technologies to be evaluated include a narrow-beam echo sounder system which has been used to assess submersed aquatic vegetation and substrate; and a side-scan and multibeam sonar, which has been used to map macro scale portions of shelf water in the Atlantic. In addition, in collaboration with the Southern California Coastal Water Research Program (SCCWRP), the team will evaluate potential modifications to the draft subtidal benthic algae collection technologies under development for the State of California. The most promising technologies will be tested, and then demonstrated and evaluated at two sites (on the east and west coasts). This demonstration will validate the accuracy of applying the current method of intertidal measurements to whole water bodies.



The standard method for estimating biomass is a manual measurement with quadrate. Kara Sorensen

The expected benefits of this demonstration will be a more robust measurement suite for determining whether a waterbody is impaired, and for TMDL monitoring, where required. A more accurate method of making this determination will help the Navy avoid the cost ramifications of overly conservative estimates.

A more accurate method of making this determination will help the Navy avoid the cost ramifications of overly conservative estimates.

The results of this demonstration will be reported in a peer-reviewed journal and a Navy-wide magazine, and will be presented to regional/state stakeholders and regulatory advisory groups in order to gain acceptance of the proposed technology. In addition, a short guidance report will be created and distributed to bases where eutrophication is identified as a potential issue. The team will work with the Southern California Coastal Water Resource Project to facilitate its acceptance by the California State Water Resources Control Board.

Kara Sorensen, Space and Naval Warfare Systems Command, 619-553-1340, kara.sorensen1@navy.mil

Project No. 512

Investigation of Improved Epi-Seal Materials for Use in General Purpose Bombs

Improving Epi-Seal Materials for Use in General Purpose Bombs

Project Addresses Sealant Leakage

When a bomb is manufactured, a tail pad is applied to confine the explosive within the bomb casing as the explosive cures. The sealant used for this purpose is called Epi-Seal (also known as Tuffseal). Throughout the bomb's shelf life, this sealant tends to leak from the aft end of the bomb, contaminating the surface of the bomb and the surrounding areas of the storage facility. This leakage issue is seen in nearly every storage location in the world, with much higher rates of leakage seen in warm storage environments. There are thousands of bombs in Navy and Air Force inventory that must be cleaned of leaked Epi-Seal material each year, resulting in thousands of hours of labor required for cleanup.

There are thousands of bombs in Navy and Air Force inventory that must be cleaned of leaked Epi-Seal material each year.

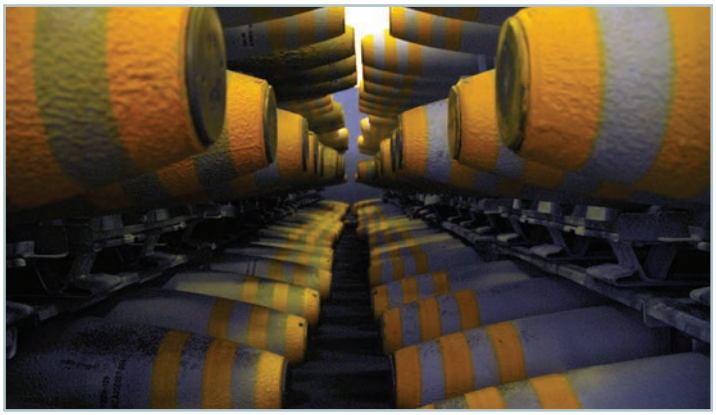
To solve this problem, a project team was formed to perform chemical analyses on the current Epi-Seal material to determine its decomposition characteristics with respect to aging, temperature exposure, humidity exposure, and mix ratios of the constituent parts. These analyses will be performed at Naval Air Warfare Center – Weapons Division in China Lake, California and Naval Air Warfare Center – Aircraft Division in Patuxent River, Maryland. Findings of this phase of the project will be used to determine how the current material can be improved upon.

Depending upon the findings of the material characterization effort, the work involved in this project will range from a slight reformulation of the current product to a dramatic revision of the Epi-Seal specification. The current

Aviation Ordnancemen prepare pallets of 2,000-pound penetrator bombs to be airlifted from the flight deck of the Nimitz-class aircraft carrier USS Harry S. Truman (CVN 75) to USS Dwight D. Eisenhower (CVN 69). Penetrator bombs are also subject to sealant leakage.

Photographer's Mate Airman Ricardo J. Reyes

Leaked Epi-Seal material on the aft surface of a 2,000-pound general purpose bomb. U.S. Air Force



One thousand-pound general purpose bombs sit stacked in the hangar bay of the nuclear-powered aircraft carrier USS Nimitz (CVN 68) in preparation for an ammunition offload. U.S. Navy

Epi-Seal formula is qualified to MIL-DTL-82633. The primary purpose of the investigation is to determine how to improve upon the existing material by determining what requirements in the specification need to be improved upon, or what requirements need to be added.

After evaluating proposed chemical and physical changes needed, the team will formulate a small batch of improved Epi-Seal. This batch will be performance tested and evaluated for its environmental impacts. Primary performance characteristics to be identified and improved are material viscosity with relation to temperature, pressure, and humidity; material softening and melting point; and the propensity of the material to break down over time (the material is intended to stay in its cured solid state for the extent of the bomb's service life). If needed, a revised disposal plan will also be developed to accompany the overall demilitarization plan for these bombs.

After the initial testing, a go/no go decision point is planned. If the project is approved to continue, re-formulation will be undertaken and additional testing performed as needed. The ultimate goal is to produce new or improved Epi-Seal material that is qualified for use in Navy and Air Force bombs and incorporated into technical data packages.

The ultimate goal is to produce new or improved Epi-Seal material that is qualified for use in Navy and Air Force bombs and incorporated into technical data packages.

At this point, the Army facility that performs explosive loading would solicit bids for production of the improved material, and would then purchase the improved tail pad material for use in bomb production.

This technology will transfer from development at Navy labs to full-scale production development by the commercial sector, to use by Army ammunition production facilities that perform explosive loading of Navy and Air Force munitions. Updated technical data packages for Navy and Air Force bombs, along with an updated specification to cover the requirements of the tail pad material, will ensure that the improved material is produced appropriately.

Epi-Seal leakage on stored bombs.
U.S. Air Force

Successful completion of this project will result in lower lifecycle costs for Navy and Air Force bombs because maintenance costs will be greatly reduced over the course of their lifetime.

John Rettig, Naval Air Warfare Center – Weapons Division, China Lake, 760-939-7061, john.rettig@navy.mil

Project No. 513

Design Closed-Loop Cooling Water System to Accommodate Ship Cooling Water Needs

Evaluating Options to Comply with New Stringent Dry Dock Cooling Water Discharge Limits

Report Provides Insights & Possible Solutions to a Complex Problem

When a ship enters dry dock for maintenance, cooling water continues to pass through its systems, resulting in millions of gallons of discharge water per day. These once-through pass cooling waters typically contain heavy metals such as copper, usually in the 10-12 parts per billion (ppb) range (based on a monthly average). National Pollutant Discharge Elimination System (NPDES) permit levels in Washington State are currently set at 19 ppb, but a draft permit will reduce the level to 2.5 ppb in the near future. New permit levels at Pearl Harbor Naval Shipyard have also just been reduced to 3.5 ppb.

Noncompliance with the new limits could result in Notices of Violation, fines, and/or possible curtailment of operations. Other regulations proposed by the U.S. Environmental Protection Agency

Noncompliance with the new limits could result in Notices of Violation, fines, and/or possible curtailment of operations.

A submarine arrives for maintenance at Puget Sound Naval Shipyard and Intermediate Maintenance Facility. This shipyard will be impacted by the new discharge limits. Jason Kaye

would regulate cooling water intake structure designs (less than half a foot-per-second water intake velocity) for facilities designed for withdrawing greater than two million gallons per day. At the same time, a new class of aircraft carrier (CVN 78) is being introduced, which will discharge even higher volumes of cooling water. The proposed federal rule will impact Navy shipyards, likely requiring significant expenditures to bring shipyard cooling water intake structures into compliance.

To document the challenges posed by these complex issues, the first phase of this project is to complete an Initiation Decision Report (IDR).

The project team from the Naval Facilities Engineering and Expeditionary Warfare Center (EXWC) has completed preliminary technology/ methodology research on different options to deal with cooling water discharge at shipyards. There are many different approaches for removing excess heat including a chiller or cooling tower, or exchange with seawater through an additional heat exchanger.

One of the most promising potential technologies is a closed-loop cooling system.

Next, the team will consult with regulators and subject matter experts in order to evaluate how new requirements may impact the Navy's mission and facilities. The team will characterize ship discharges, designs, and infrastructures; and develop conceptual options for technologies and management approaches to meet the new compliance requirements. Potential approaches will be ranked and evaluated by EXWC and Navy project partners. The next step will be to develop conceptual system design and rough cost estimates. Study findings will be documented in the IDR and pending a favorable go/no go decision, phase two of the project will develop detailed technical feasibility and cost analysis for the most promising option(s).

USS Greeneville in dry dock at Pearl Harbor Naval Shipyard. Even in dry dock, cooling water continues to run through some ship and submarine systems.

One of the most promising potential technologies is a closed-loop cooling system. The main advantage to this system is that discharge issues with metals and chlorination will be eliminated as cooling water will not be allowed into the harbor.

A closed-loop system would also aid in addressing a related problem, bio-fouling of intake water which sometimes occurs when saltwater from a harbor location enters a ship's cooling water system. Not only can a closed-loop system use potable water, but if anti-fouling chemicals are needed, they can be added without any adverse environmental effects.

A closed-loop system does produce a small volume of wastewater, but this can easily be contained, disposed, and treated if necessary. The drawbacks to a closed-loop system are higher operational cost, and acceptance with the users to ensure ship's requirements are met during dry dock operations. Available space and excessive noise might also be issues.

The optimum approach can have a tremendous positive impact in terms of reducing the cost of ship maintenance and ensuring compliance with new regulatory standards. Additionally, the solutions proposed at the conclusion of this project have potential for reducing bio-fouling of ship systems, which is in itself a well-characterized issue.

Integration will proceed with help from personnel from the Naval Sea Systems Command who are partnering in this effort.

Sonny Maga, Naval Facilities Engineering and Expeditionary Warfare Center, 805-982-1340, sonny.maga@navy.mil

Project No. 514

Enhanced Trivalent Chromium Pretreatment for Improved Coloration and Corrosion Performance of Aluminum Substrates

Adapting a Trivalent Chromium Pre-treatment Process

Adding Color to the Formulation is Key to Use at Fleet Readiness Centers

Conversion coatings are pretreatments used for the surface finishing of aluminum to improve corrosion performance and adhesion of subsequent coatings (primer, paint, and sealants). Historically, conversion coatings used on aircraft and components at Fleet Readiness Centers (FRC) have contained hexavalent chromium (Cr+6). However, Cr+6 is now a known carcinogen, and reduced usage of the chemical is a command-wide requirement.

To help meet this requirement, personnel from the Naval Air Systems Command (with support from the NESDI program) developed an alternative process known as the trivalent chromium process (TCP). TCP is a drop-in replacement for hexavalent chromium formulated using hexafluorozirconate compounds and trivalent chromium salts. This process has proven extremely effective as a post-treatment in surface finishing and electroplating. However, widespread use of this process as a pre-treatment has been hampered because the current formula does not change the color of the aluminum substrate upon application which is integral to quality control and as an aesthetic requirement.

Aluminum substrates which have been conversion coated with Cr+6 can be easily identified by their iridescent, gold/green color. Because no such color change occurs following the trivalent chromium process, it is very difficult to visually check that the trivalent conversion coating has been applied. This hinders the quality assurance processes at Navy FRCs.

Widespread use of this process as a pre-treatment has been hampered because the current formula does not change the color of the aluminum substrate.

Conversion coatings are used on EA-6B aircraft.

MC Specialist 3rd Class Joshua Card

Conversion coatings are used on EA-6B aircraft.
MC Specialist 3rd Class Raul Moreno Jr.

Conversion coatings are used on H-60 aircraft.
MC Specialist 3rd Class Joshua Card

The goal of this project is to combine a commercially available color additive with a TCP solution to produce a visible color change to the aluminum substrate, indicating that the trivalent conversion coat process has been performed.

The first task facing the project team is a quantitative electrochemical analysis performed on small test squares (also known as coupons) of aluminum. Down selection will be based upon the best performing combination(s) of TCP formula, color additive, and color additive concentration.

Down selection will be based upon the best performing combination(s) of TCP formula, color additive, and color additive concentration.

This enhanced trivalent chromium process (eTCP) will then be performance-tested and evaluated based on corrosion performance, quantitative electrochemical analysis, color change, and paint adhesion. This scale-up demonstration and validation process will be performed initially at the FRC at Naval Air Station Jacksonville.

Optimization and subsequent authorization for use in both the immersion and spray application will allow eTCP to aid in the elimination of hexavalent chromium from depot level maintenance operations across FRCs. In addition to reduced health hazards, the lifecycle cost advantages of adopting eTCP include reduction of labor and materials costs associated with heavy metals decontamination, reduction of engineering control technology requirements, and elimination of hexavalent chromium reduction for wastewater processing.

Initial Navy users would be FRCs that currently utilize Cr+6 conversion coating of aircraft components. Users that already perform these processes would have the necessary tank immersion infrastructure to allow eTCP as a drop-in replacement, limiting facilities modification.

Engineering documents (including Local Process Specifications, military specifications as well as technology authorization letters) will be created to direct use of eTCP for conversion coating of aircraft components. In addition, the hazardous material authorization use list of applicable FRC work centers will be updated to include eTCP materials, and eTCP will be incorporated into the Naval Air Systems Command's Chemicals of Concern Listing as a primary alternative to hexavalent chromium for acquisition programs.

Peter Sheridan performs an initial feasibility study of commercial off the shelf color additives combined with eTCP formulations.
Jack Benfer

Peter Sheridan, Fleet Readiness Center Southeast, 904-790-6382, peter.sheridan@navy.mil

Project No. 515

Underwater Remotely Operated Vehicle Mounted Ultra-High Pressure Waterjet Cutter Tool for Underwater Munitions Breaching

Towards Remotely Operated Underwater Munitions Cleanup

Innovative Technology Would Eliminate EOD Diver Risk

Munitions response sites are locations that are known or suspected to contain unexploded ordnance, discarded military munitions, or munitions constituents. The Navy has approximately 57 shallow water (under 120-feet deep) munitions response sites (MRS) that may need to be remediated. Currently, the only feasible method of addressing this situation is through the use of divers that have been trained in explosive ordnance disposal (EOD) methodology and techniques. However,

Diving operations by their nature are considered hazardous without the additional risk of dealing with explosives.

diving operations by their nature are considered hazardous without the ad-

There are currently approximately 57 shallow water munitions response sites in need of remediation. U.S. Army Corps of Engineers

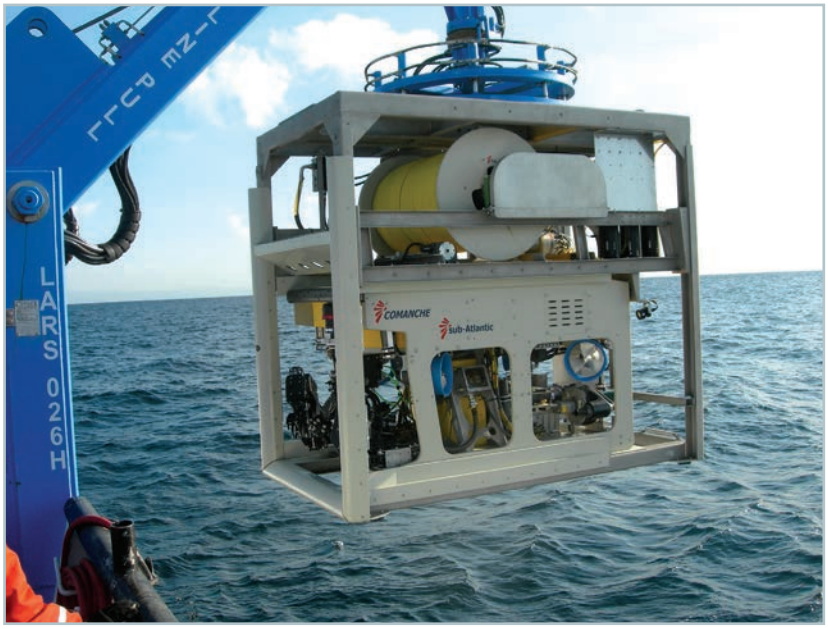
ditional risk of dealing with explosives. Since the goal is to minimize all hazards and/or risks where feasible, the Navy is looking for alternative, cost-effective methodologies that would eliminate the use of divers in this process.

One such methodology is being pursued by a project team from Naval Facilities Engineering Command Engineering and Expeditionary Warfare Center (NAVFAC EXWC). The team is merging a commercial-type underwater remotely operated vehicle (ROV) with commercially available ultra-high pressure (UHP) waterjet cutting technology to create a system capable of breaching underwater munitions.

Breaching of underwater munitions allows access to the munitions filler material in order to facilitate the remediation objective, whether that be removal, leave-in-place, or a combination of various solutions. Use of this technology would eliminate the potential negative effects and risks associated with the use of explosives and divers to breach underwater munitions in conjunction with cleanup mitigation.

The goal of the project is to create a system that can be effectively employed in water depths of less than 120 feet.

Waterjet cutting has been used to effectively cut various types of underwater structures (e.g. caissons, piping, cables, etc.) during repair, maintenance, and salvage operations and is effective on most materials, including steel, aluminum, and concrete. Waterjet cutting is a cold cutting process which, unlike thermal cutting processes (welding, saws, etc.), does not generate enough thermal energy to potentially act as an ignition source. Waterjet cutting forces ultra-high pressure water (up to 55,000 pound-force per square inch) through a tiny hole to concentrate an extreme amount of energy in a small area. An environmentally inert abrasive (garnet) is added to the stream, allowing the erosive cutting process to occur.



EXWC's Comanche ROV shown inside its tether management system, used when the ROV is launched at sea. Greg Cooper

Research, development, and use of UHP waterjet cutting for terrestrial demilitarization of munitions has been performed since the 1990s by private industry.

The goal of the project is to create a system that can be effectively employed in water depths of less than 120 feet without the extensive engineering design and materials required by a deep water subsea waterjet cutting unit.

The system will leverage commercially available UHP waterjet cutting components to be integrated with NAVFAC EXWC's work-class ROV. This will require equipment modifications to be performed for mounting a waterjet cutting tool to the ROV's manipulator arm for testing purposes. An initial demonstration is planned for the fall of 2015, with a second demonstration contingent upon the success of the first.

Users of this technology will be Navy Remedial Project Managers and commercial unexploded ordnance contractors involved in implementation planning at an underwater MRS.

Use of a non-explosive and non-diver technology would eliminate the potential negative effects and risks associated with the use of explosives and divers to breach underwater munitions in conjunction with cleanup mitigation.

Steven Hammett, Naval Facilities Engineering and Expeditionary Warfare Center, 805-982-4839, steven.a.hammett@navy.mil

Project No. 516

Develop an Automated Real-time Opacity Monitor for Use in Determining the Opacity of Fugitive Emissions

Controlling Opacity at Puget Sound

New Methodology Sought to Reduce the Burden of Complex Control Measures During Ship Dismantling

When a ship or submarine reaches the end of its service life, facilities such as Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS&IMF) are tasked with dismantling it into scrap metal. This is most often accomplished through the use of oxygen/fuel cutting torches (i.e. hot cutting) because of the efficiency, adaptability and low risk of repetitive injury associated with torch cutting. This process generates plumes of smoke and metal fumes with the potential to exceed the Visible Emission Standard. At PSNS&IMF this standard is an especially stringent 20 percent opacity. This limit was defined by the U.S. Environmental Protection Agency (EPA), is legislated by the Washington State Clean Air Act, and enforced by the local regulating body, the Puget Sound Clean Air Agency (PSCAA).

Presently and increasingly in the future, managers at PSNF&IMF spend a significant level of effort and resources mitigating air emissions from hot cutting. The Inactivation, Reactor Compartment Disposal and Recycling program at the facility has certified personnel to conduct visible emission monitoring using the standard protocol defined by the EPA (Method 9). However, the results have provided an unacceptable margin of error and place excessive burden on the certified opacity readers and the production personnel who rely on the timely receipt of these readings.

Ship in drydock at PSNS&IMF. MC Specialist Seamen Jose L. Hernandez

Therefore, PSNS&IMF has moved to using tent-like structures with ventilation to control visible emission from hot cutting operations on submarines. Use and sustainment of these structures is expensive, impacts productivity, and is considered a cumbersome work practice. Additionally, this approach is not practical for recycling large surface combatants due to their size and the variation in the approach needed to dismantle these vessels. Therefore, a need exists to find practical technologies that can be applied cost effectively in the shipyard environment to solve or reduce the burden of increasingly complex and costly opacity control measures during ship dismantling.

Use of these structures is expensive, impacts productivity, and is considered a cumbersome work practice.

This effort was formed to identify and leverage instrumentation capable of providing instantaneous opacity determination of fugitive emissions. Naval Surface Warfare Center, Carderock Division is teaming with Sigma Space to optimize the Mini-Micro Pulse LIDAR (MPL) for operations within the naval shipyard facilities environment. LIDAR (Light Detection and Ranging) technology works by illuminating a target with a laser and analyzing the reflected light. LIDAR was first tested and proven to quantitatively measure smoke plume (i.e. visible emissions) in the late 1960s and 1970s, and it is currently used extensively by meteorologists, atmospheric and environmental regulators, airports and air traffic controllers, and more recently wind farm planners.

EPA has concluded that LIDAR is an accurate technology to measure plume opacity during all hours of the day, independent of lighting conditions, and that it is an acceptable alternate to reference Method 9. However, this technology has been used to make long distance measurements, and will require some additional development to make it useable as a handheld or otherwise man-portable device with the ability to be deployed in different locations, which is the preferred configuration for PSNSY or any industrial operation doing similar work. Team members will modify an existing MPL to reduce the stand-off distance from 100 meters to 30 meters, and make minor data changes to display measured opacity in percentages. The device will ultimately be adapted from its current purpose as a stationary, long-range, highly accurate monitoring system to a highly mobile, short-range system with the ability to be deployed in the shipyard environment and provide the opacity records needed to prove compliance or determine appropriate opacity mitigation tactics.

The handheld LIDAR captures data through an internal Global Positioning System reading, and reporting can be obtained from raw data to prove compliance. This technology can provide instantaneous measurement of opacity and will be able to collect/store data, report data, and alarm within 30 seconds if an exceedance of 20 percent opacity has been reached. The project team plans to demonstrate an MPL system and advance the effort to obtain approval from the EPA and PSCAA as an alternative method for complying with EPA Method 9 for opacity measurement.

The hot cutting process on a submarine hull sample. Jim Howell

This technology will provide a means to reduce the burden of employing large-scale containment and ventilation solutions currently employed at PSNS&IMF. The method will allow timely, application-driven monitoring of open burning or localized ventilation strategies. The nature of the near-range, mobile device will enable it to be applied to any ship, including surface combatants that currently have no containment options.

EPA has concluded that LIDAR is an accurate technology to measure plume opacity during all hours of the day.

As the MPL system will be demonstrated at PSNS&IMF, transition is anticipated to occur on-site. Once EPA and PSCAA approval is obtained, the shipyard can adopt the technology and expand its use. Results of the project will be compiled in a final report.

Patrick Morrow, Naval Surface Warfare Center, Carderock Division, 301-227-5176, patrick.r.morrow@navy.mil

The NESDI Program Process

4. Integrate Solutions

Throughout the project lifecycle, program personnel concentrate on moving the demonstrated technologies and other solutions out of the laboratories and demonstration sites and into the appropriate operational environment. During this fourth and final phase of the NESDI program process, the TDWG, Principal Investigators and technology integration specialists (for NAVFAC-led projects) work together to ensure that various solutions are successfully integrated into the Fleet and weapons system acquisition programs and verify that the solutions provide the anticipated benefits.

Under project 464, waste water is being used for subterrain irrigation.

Sonny Maga

2014 Project Closeouts

The following projects ended in FY14.

No.	ID	Title
1.	348	Nanocrystalline Cobalt Phosphorous (nCoP) Electroplating as a Hard Chrome Alternative
2.	450	Cadmium Tank Electroplating Alternative
3.	462	Environmental Effects of Military Expendable Material
4.	470	Cyanide Waste Reduction of Electroplating and Stripping Processes
5.	473	Dynamic Mixing Zone Modeling
6.	480	Alternative Metal Hot Cutting Operations For Opacity
7.	482	Innovative Cutting Process to Vent Full Scale Non-Explosive Practice Munitions
8.	483	Transportable Field Melter for Recycling of Bombing Range Material Potentially Presenting an Explosive Hazard (MPPEH)
9.	484	Replacement of Film Radiography with Computed Radiography (CR)
10.	488	Excess Paint Reduction
11.	490	Application of the Marine Biotic Ligand Model (BLM) for Copper to Evaluate Risks Associated with Olfactory Responses in Salmonids and Forage Fish
12.	491	Implementation Strategy for Coral Reef Transplantation Methods in Support of Natural Resource Planning, Management and NEPA Compliance

2014 Project Closeouts *(continued)*

Some notable successes in closeout projects are summarized below:

Project 348: Nanocrystalline Cobalt Phosphorous (nCoP) Electroplating as a Hard Chrome Alternative

A new military specification (MIL-DTL-32502) has been officially released for nCoP alloy electrodeposits. Field testing on various nCoP-treated aircraft parts has proven successful and is ongoing. (See page 21 for more on this project.)

nCoP-treated T-45 part (project 348).

Project 450: Cadmium Tank Electroplating Alternative

This project validated an electroplating process to eliminate the use of cadmium at the depot level. The process has been cleared for use in two FRCs through local process specifications. (See page 23 for more on this project.)

Project 470: Cyanide Waste Reduction of Electroplating and Stripping Processes

This project devised non-cyanide silver electroplating and strip processes to remove cyanide from the waste stream. This process is currently being used under a temporary order at FRC Southwest, and personnel there are training Norfolk Naval Shipyard workers in its use.

Project 482: Innovative Cutting Process to Vent Full Scale Non-Explosive Practice Munitions

Typically, composition C4 explosives are used for defusing practice bombs. However, this practice leaves residual explosive matter in the soil. This project utilized a drilling process to defuse the bombs, eliminating the need for C4 use. Range managers have been educated on the process, and the final report has been published.

The bomb drill (project 482).

Project 490: Application of the Marine Biotic Ligand Model (BLM) for Copper to Evaluate Risks Associated with Olfactory Responses in Salmonids and Forage Fish

This project studied juvenile salmon to determine that the current model for determining exposure to copper was sufficiently protective. The team developed a new user-friendly version of the model to be used for regulatory purposes.

2014 Project Successes

A number of ongoing NESDI projects were particularly successful in FY14. Some notable successes include:

Project 440: Surface Cleaning of Drydock Floors

Jim Howell, Principal Investigator

This project developed a method and vehicle for removing hazardous wastes from dry dock floors. All primary vehicle systems have been installed. Vehicle systems (including propulsion, high pressure water, and air recovery systems) have been individually tested and operated, and total system optimization is underway.

The cleaning vehicle is currently undergoing the finishing touches.

Project 455: Modeling Tool for Navy Facilities to Quantify Sources, Loads, and Mitigation Actions of Metals in Stormwater Discharges

Chuck Katz, Principal Investigator

The purpose of this effort was to demonstrate and validate the Source Loading and Management Model for Windows (WinSLAMM) stormwater management model so that Navy facilities managers can identify potential sources of metals, particularly copper and zinc, in stormwater runoff. In FY14, the team completed a report detailing the outcome of the modeling tool calibration results and delivered the report to 29 facility end users. The team also generated a draft guidance document for site characterization to be used by Navy facility managers.

Galvanized metal pipes contribute to metals loading in stormwater runoff.

Project 458: Advanced Non-Chromate Primers and Coatings

Julia Russell, Principal Investigator

In an effort to remove hexavalent chromium from the waste stream, this team demonstrated and validated a new, state-of-the-art non-chromate primer and drafted an authorization letter to allow seven aircraft platforms to use it. In addition, a two-year F/A-18 demonstration/validation was initiated.

Applying primer to a P-3C Orion.

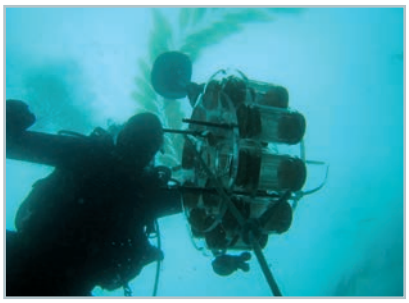
2014 Project Successes *(continued)*

Project 459: Demonstration and Validation of Sediment Ecotoxicity Assessment Ring Technology for Improved Assessment of Ecological Exposure and Effects

Gunther Rosen, Principal Investigator

The goal of this effort was to demonstrate, validate, and promote regulatory acceptance of an integrated in situ bioassessment tool, the Sediment Ecotoxicity Assessment Ring, developed under a SERDP project. The team conducted a successful field stormwater demonstration at Naval Base San Diego and remedy performance monitoring at Bremerton and Quantico. A report was also published on EPA's Environmental Technology Verification (ETV) web site which verifies new technologies enabling purchasers, regulators and others to make decisions on adoption of these new technologies.

Testing sediment recovery success of SEA Ring commercial prototype.
Gunther Rosen



Water column deployment of first generation SEA Ring near Scripps Institution of Oceanography.
Rolf Schottle

Project 464: Tertiary Treatment and Recycling of Waste Water

Sonny Maga, Principal Investigator

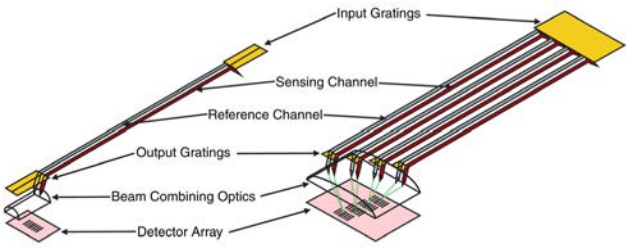
This project team developed a manmade wetland for onsite reclamation and reuse of waste water. In FY14, they received a permit allowing the use of the reclaimed treated water for subterrain irrigation at Marine Corps Recruit Depot San Diego and gave a preliminary design and cost estimate to connect to the tidal wetland treatment system with subterrain irrigation system.

The Living Machine waste water treatment system at MCRD San Diego.

Project 468: Low Cost Selective Polymer and Laser Interferometer Real Time Sensors for Detection of Solvents in Contaminated Groundwater Plumes

Issis Long, Principal Investigator

The objective of this project is to demonstrate and validate optical sensor technology to detect groundwater contaminants in real time and to enable remote access to these data. In FY14, the team developed a process to effectively lay down thin multi-polymer channels on the waveguide and designed and constructed new laser interferometer camera and software to support the waveguide. A demonstration/validation is planned for first quarter FY15 at Crane, Indiana, with sampling to occur in the same quarter.



Single and multi-channel interferometer.

Project 469: Validation of a Low Tech Stormwater Procedural Best Management Practice

Chuck Katz, Principal Investigator

This team validated that power vacuuming and high-pressure washing of impervious surfaces reduced average loading of copper and zinc on three San Diego piers by 75 percent and 40 percent, respectively. The final technical document was produced and sent to 29 Navy end users.

Power washing technology at work.

2014 Project Successes *(continued)*

Project 478: Improving Non-Hazardous Solid Waste Diversion

Jill Hamilton, Principal Investigator

In an effort to reduce food waste, this team produced a guidance document including a matrix to identify installations where food diversion would be beneficial, and which technologies would be suitable for candidate sites. In addition, plans were initiated for phase 2, including the implementation of a bin-system at an appropriate installation, and survey of technologies currently installed at installations.

Signs such as these in mess halls help improve food waste separation.

Project 485: Demonstrate/ Validate Alternatives to Methylene Chloride-based Chemical Paint Strippers

Luc Doan, Principal Investigator

The laboratory testing and demonstration/validation portions of this project wrapped up in FY14, with one exception. Alternative thixotropic paint strip testing on E-2 Hawkeye Rotodome must be repeated due to earlier equipment failure.

Non-methylene chloride based paint remover.

Project 486: Qualification of Type 8 Plastic Media Blast (PMB) as a Replacement for Chemical-based Strippers and Type 5/7 PMB

Nicole Hansen, Principal Investigator

This team found that Type 8 media (Magic PMB) met performance requirements when used as specified—however there is a risk of damage when media is used above specified pressures. Authorization letters and a final report are still pending but all sites that may use Magic PMB are currently using it.

Use of PMB will eliminate the corrosive attacks associated with chemical usage.

Project 489: Oil Boom Biofouling Control by Mechanical Intervention and Material Technologies

Matt Naiman, Principal Investigator

To help mitigate the need for frequent oil boom cleaning, this project tested a protective, silicone-based coating. Prototype boom sections (with and without coating) were installed in three locations in FY14. Results of the first field test indicate that the coated boom cleaned twice as easily as uncoated boom in out-of-water cleaning. The results were promising for in-water cleaning as well. Next, the team needs to complete additional cleaning and mechanical testing.

This project utilized the same nonstick coating used to treat netting on fish pens.

Project 494: Successful Municipal Separate Storm Sewer System (MS4) Programs Implemented in the Navy

Edwin Chiang, Principal Investigator

It is expected in the near future that regulators will enforce the requirement that all military bases acquire an MS4 permit. This project produced a guidance document to assist in complying with their MS4 permits efficiently. The document includes comparisons of cost and acquisition strategies to implement various methodologies.

A bioretention planter helps capture and reduce stormwater runoff.

Looking Forward

As FY15 begins, we have 35 active projects with nine set to close out at the end of the fiscal year. Our renewed focus on accountability will extend into FY15 and beyond and include detailed management plans at the onset of our new projects and monitoring the status of our active projects to ensure that project expenditures stay on track and program obligation and expenditure benchmarks are met.

We will also continue to push for the integration of our validated technologies, processes and materials into the ongoing operation of the Fleet. Leveraging a number of Navy working groups (including the Water Media Field Team, Alternative Restoration Technologies Team, and Corrosion Fleet Focus Team) will help during the validation process and as we move toward integration. Also during FY15, the NESDI program will more closely leverage its efforts with the research being sponsored by ESTCP, especially as that research pertains to the elimination of cadmium and chromium.

These focus areas of accountability, integration and leveraging will be underscored during the site visits that have already been scheduled to accompany our In-Progress Reviews in FY15. Visit our web site at www.nesdi.navy.mil to get the latest information about the program throughout the course of the year.

Our FY15 Schedule

No.	What	When
1.	Pre-proposals DUE	17 November 2014
2.	Make Pre-proposals Assignments to FWGs	24 November 2014
3.	TDWG & FWG Comments on Pre-proposals DUE	5 December 2014
4.	Evaluate Pre-proposals	8-12 December 2014
5.	Request Full Proposals	17 December 2014
6.	Full Proposals DUE	18 February 2015
7.	FWG Comments on Full Proposals DUE	13 March 2015
8.	TDWG Comments on Full Proposals DUE	20 March 2015
9.	Screen Full Proposals	23-27 March 2015
10.	Conduct Stormwater and East Coast In-Progress Review	13-17 April 2015 (Virginia Beach, VA)
11.	Principal Investigator Answers to Full Proposal Screening Questions DUE	27 April 2015
12.	Conduct West Coast In-Progress Review	4-8 May 2015 (San Diego, CA)
13.	Evaluate Full Proposals	11-15 May 2015
14.	Announce FY16 Needs Solicitation	1 June 2015
15.	Obtain Sponsor Review & Approval of Full Proposals	8 June 2015
16.	Announce FY16 New Starts	30 July 2015
17.	Close FY16 Needs Solicitation	3 August 2015
18.	Screen Needs	10-14 August 2015
19.	Evaluate & Rank Needs	14-18 September 2015
20.	Obtain Sponsor Review & Approval of Needs	21 September - 8 October 2015
21.	Request Pre-proposals	14 October 2015
22.	Conduct OPNAV N45 Programmatic Review	October 2015
23.	Quarterly Status Reports Due (all Mondays)	5 January 2015 6 April 2015 6 July 2015 5 October 2015

Check out our web site (www.nesdi.navy.mil) for the latest version of our program schedule.

Priority Investment Areas

The NESDI program makes its primary investments in the following EECs in order of priority:

1. **Range Sustainment (EEC-2).**
   In this area, the NESDI program invests in innovations that address environmental impacts and restrictions to ensure that naval training ranges and munitions testing/manufacturing ranges are fully available and efficiently utilized. Example projects in this area are:
   a. *Innovative Drilling Process to Vent Full Scale Non-explosive Practice Munitions*.
      Typically, composition C4 explosives have been used to defuse practice bombs. However, C4 has been found to leach into the soil and has the potential to migrate offsite. This project successfully demonstrated a remote-controlled bomb drill that defuses these bombs without explosives.
   b. *Demonstration of Passive Samplers for Assessing Environmentally Realistic Concentrations of Munitions Constituents at Underwater UXO Sites*.
      This project team conducted a controlled field validation of passive sampler technology with Composition B explosive and verified the ability of samplers to detect ultra-trace levels of munitions constituents such as RDX and TNT.
   c. *Environmental Effects of Military Expendable Material (MEM)*.
      This project assessed the potential environmental impacts from high-priority MEMs including torpedo copper guidance wire and sonobuoy decelerators (parachutes) to provide information necessary to support range complex environmental planning efforts.

2. **Weapon Systems Sustainment (EEC-3).**
   In this area, the NESDI program invests in solutions to reduce the cost of compliance and increase readiness for Fleet maintenance personnel. Example projects include:
   a. *Low-VOC and Low-HAP Wipe Solvent and Paint Thinner Demonstration/Validation*.
      This team plans to demonstrate and validate that a low-volatile organic hazardous air pollutant and a low-volatile organic compound solvent can serve as a "drop-in" solution to the environmental issues associated with the current coating thinner used in naval aviation coatings and solvent cleaning applications.
   b. *Replacement of Film Radiography with Computed Radiography*.
      Because conventional film radiography requires the use and management of hazardous materials including potassium sulfite, hydroquinone, ammonium thiosulfate, and sodium sulfate, this project has drafted an authorization letter to use computed radiography in its place.
   c. *Portable Treatment for Ship Material Removal Processes*.
      This project was formed to quantify the extent of escalating costs of wastewater disposal generated from water blasting processes performed at Navy shipyards, and to test a mobile wastewater treatment system. The final system is expected to be completed and sent to Puget Sound for testing in FY15.

3. Ship-to-shore Interface and Air and Port Operations (EEC-4).

In this area, the NESDI program invests in innovative techniques to manage ship hazardous material/waste offload to shore facilities as well as approaches for addressing issues pertaining to air and port operations that ensure Fleet readiness. Example projects in this investment area are:

a. *Dry Dock Sediment Management*.
This effort tested a commercial off-the-shelf vehicle for cleaning dry dock floors in an effort to reduce runoff and meet National Pollutant Discharge Elimination System requirements. This effort also determined that there was no need to regularly allocate funds/labor for cleaning out discharge tunnels as cleaning practices prevent sediment from entering them.

b. M*ethodology to Assess Essential Fish Habitat for Navy Coastal Properties*.
In order to expedite Essential Fish Habitat consultations, marine resource managers need to understand how fishes use bays and harbors. This project team implemented multiple approaches to create a predictive model that will help managers score the relative importance of areas within San Diego Bay.

4. Regulatory and Base Operations (EEC-5).

In this investment area, the NESDI program sponsored cost-effective methods for identifying, analyzing, and managing environmental constraints related to current and projected regulatory impacts. Example projects include:

a. *Low-Impact Development (LID) for Industrial Areas*.
The project team has compiled a draft decision support document which identifies, evaluates, and provides guidance on LID practices capable of reducing volume and removing pollutants from stormwater runoff.

b. *Remove Copper and Other Heavy Metals from Oily Water Treatment System (OWTS) Discharge for Compliance with NPDES Discharge Standards*.
This project demonstrated an enhanced OWTS at Puget Sound Naval Shipyard. The goal of this pilot system is to enhance compliance by eliminating the use of alum (aluminum sulfate) and polymer during coagulation/flocculation and replacing bag and media filters with ceramic membrane filtration (CMF) technology.

c. *Capacitive Deionization Water Treatment System*.
This project is improving on the application of Capacitive Deionization (CDI) for the treatment of drinking water at small or remote locations. CDI is an electrochemical water treatment method that will work with near energy-neutral requirements. It is expected to perform comparably to a reverse osmosis system at significantly less cost.

Promoting Our Successes

Successful NESDI projects were promoted throughout FY14 in a variety of print and on-line publications. In addition to this Year in Review report, an annual programmatic review, and the program's web site, the NESDI program also sponsors a quarterly newsletter, generates project fact sheets, and regularly publishes stories in *Currents*—the Navy's energy and environmental magazine. The program has also generated several videos to promote the results of some of our more successful projects—all available via the NESDI web site.

Quarterly Newsletters

NESDI News: Highlights and Happenings—the program's quarterly electronic publication—brings recent technical achievements and regulatory concerns to the forefront, along with highlights on our technical staff. We published four issues of our newsletter in FY14.

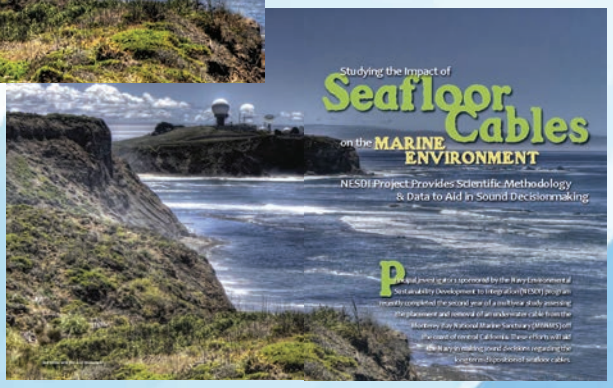
Fact Sheets

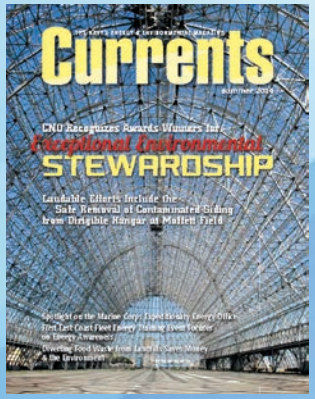
In an ongoing effort to promote the program's active and completed projects, we developed dozens of online fact sheets that highlight the objectives and latest progress made by ongoing NESDI projects and the accomplishments of completed projects.

Currents Articles

The NESDI program published at least one article in each issue of *Currents* in FY14, including the following articles:

- Studying Military Expended Materials in the Marine Environment: NESDI & ESTCP Projects Assess Impact of Materials, Develop Biodegradable Substitute
- NESDI & ONR Sponsor Technology to Control Paint Overspray in Shipyards: Enclosure Prevents Paint Contaminants from Reaching Air & Water
- Studying the Impact of Seafloor Cables on the Marine Environment: NESDI Project Provides Scientific Methodology and Data to Aid in Sound Decisionmaking
- Diverting Food Waste from Landfills Saves Money & the Environment: NESDI Project Includes New Guidance Document for Navy Solid Waste Managers
- NAVAIR Finding Alternatives to Hexavalent Chromium & Cadmium: NESDI-sponsored Projects Targeting Primers & Coating Methods





To browse the *Currents* archives, visit the Department of the Navy's Energy, Environment and Climate Change web site at http://greenfleet.dodlive.mil/currents-magazine.

For More Information

For more information about the operation of the NESDI program, contact Ken Kaempffe or members of the program's TDWG at the following phone numbers and email addresses:

No.	Name	Command	Phone	Email
1.	Kaempffe, Ken (Chair)	NAVFAC	805-982-4893	ken.kaempffe@navy.mil
2.	Bendick, John	NAVSUP	717-605-9144	john.bendick@navy.mil
3.	Bixler, Christy	NAVFAC/CNIC	202-685-9313	christy.bixler@navy.mil
4.	Earley, Pat	SPAWAR	619-553-2768	patrick.earley@navy.mil
5.	Hertel, Bill	NAVSEA	301-227-5259	william.hertel@navy.mil
6.	McCaffrey, Bruce	Consultant	773-376-6200	brucemccaffrey@sbcglobal.net
7.	Rasmussen, Eric	NAVAIR	732-323-7481	eric.rasmussen@navy.mil
8.	Sugiyama, Barbara	NAVFAC	805-982-1668	barbara.sugiyama@navy.mil
9.	Venable, Bill	NAVFAC	805-982-1674	william.venable@navy.mil
10.	Webber, Cindy	NAVAIR	760-939-2060	cynthia.webber@navy.mil
11.	Youngers, Luzmarie	NAVAIR	904-790-6396	luzmarie.youngers@navy.mil

To get the latest information about the program, participate in the ongoing execution of our projects, and download electronic copies of this and other Year in Review reports, visit the NESDI program web site at www.nesdi.navy.mil.

To subscribe to our quarterly newsletter, *NESDI News: Highlights and Happenings*, send your email address to Lorraine Wass at ljwass@outlook.com or 207-384-5249.

Document preparation assistance and graphic design services were provided by Bruce McCaffrey Consulting, Inc.

Accomplishments of the
Navy Environmental
Sustainability Development
to Integration Program

Ken Kaempffe
Naval Facilities Engineering and Expeditionary Warfare Center
1000 23rd Avenue
Port Hueneme, CA 93043

2014

YEAR IN REVIEW REPORT

Accomplishments of the Navy Environmental Sustainability Development to Integration Program

Available for download at: www.nesdi.navy.mil