



Panama City

YEAR IN REVIEW

FISCAL YEAR 23

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ACRONYMS

ATR	Automated Target Recognition	MP	Mission Package
DOD	Department of Defense	NAVSEA	Naval Sea Systems Command
EOD	Explosive Ordnance Disposal	NSWC	Naval Surface Warfare Center
FY	Fiscal Year	ONR	Office of Naval Research
LCS	Littoral Combat Ship	PCD	Panama City Division
LWIC	Littoral Warfare Innovation Cell	RD&E	Research, Development, Test and Evaluation
MCM	Mine Countermeasures	USV	Unmanned Surface Vehicle
MIREM	Mine Warfare Readiness and effectiveness Measuring	UUV	Unmanned Underwater Vehicle

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FOREWORD

from the **Commanding Officer
& Technical Director**

As we stand at the threshold of another fiscal year, we look back on the accomplishments we have achieved and we look forward, with anticipation, towards goals yet to be reached. It is important to document the events and milestones Naval Surface Warfare Center Panama City Division (NSWC PCD) personnel have attained, because our past successes act as our compass as we navigate into the future.

The 2023 Annual Report serves to capture those accomplishments and celebrates our command's contributions to the warfighter. In this issue, we feature some of the highlights from fiscal year 2023 to include automated target recognition (ATR) on minehunting helicopters and unmanned surface vehicles. Our Littoral & Mine Warfare Systems Department's in-service engineering agent delivered a software version, which incorporates the first of its kind ATR capability to significantly reduce the detect-to-engage timeline and fully meets the requirements of the Mine Warfare sonar mission.

Personnel from our Expeditionary and Maritime Systems Department held a waterside symposium on joint interoperability and irregular warfare to showcase the new, leading-edge Navy Enterprise Tactical Command and Control design our Navy Lab is developing. The end goal of this effort is to develop a better product for the warfighter.

The development of a suite of simulation tools from our Science & Technology Department for the improvement of underwater acoustic communication was another NSWC PCD success. These communication links allow for better pre-mission analysis of communications systems and development of next generation high-speed communications to meet the demands of national defense strategies and support the Navy's objectives.

We were exceptionally proud to have all the NSWC PCD support and technical departments come together for the command's first-ever PCD Day. With more than 800 people in attendance, PCD Day was an opportunity for each department to showcase their talents and educate the workforce on how the command works together to support the fleet.

We have faced many challenges, and the world remains unsettled and continues to rely on our Navy for missions of national interest and strategic deterrence, and be ready to conduct prompt and sustained combat operations. NSWC PCD will continue to support our Navy of today, tomorrow, and the Navy after next.

As we make headway into another extraordinary year, we are honored to serve as your commanding officer and technical director.

Thank you for your honor, courage, and commitment.



CAPT David Back, USN
Commanding Officer
NSWC PCD



Dr. Peter Adair, SES
Technical Director
NSWC PCD

An aerial photograph showing a large industrial and military facility. In the foreground, a large ship is docked at a pier. Behind it, there are numerous buildings, parking lots filled with vehicles, and various pieces of equipment. The facility is situated along a body of water.

ABOUT



Located on St. Andrew Bay in Panama City, Fla., Naval Surface Warfare Center Panama City Division (NSWC PCD) is the U.S. Navy's principal organization responsible for Research, Development, Test, and Evaluation (RDT&E) in its core mission areas and other missions that take place in the coastal region. With the Navy Lab's technical expertise, coupled with its geographical location on the Gulf of Mexico and the Department of Defense's Joint Gulf Test Range, this division is a leading contributor in developing, fielding, and testing joint expeditionary, and coastal operations systems in the littoral environment. This report documents the successful accomplishments achieved in FY23.

WORKFORCE IN NUMBERS

1,628 EMPLOYEES

136 NEW HIRES **57** RETIREES

1,299 CONTRACTORS

591 ON SITE **708** OFF-SITE

37 MILITARY PERSONNEL

21 ACTIVE DUTY

1 PERSONNEL EXCHANGE
PROGRAM (PEP)

15 PERSONNEL FORCE
INNOVATION (PFI)

797 BACHELOR'S
DEGREES

437 MASTER'S
DEGREES

71 DOCTORATE
DEGREES

970 Total scientists
& engineers

TECHNICAL CAPABILITIES

Full Spectrum Mine
Warfare to include Tactics

Expeditionary
Maneuver Warfare

Ship to Shore Maneuver to
include Air Cushion Vehicles

Full Spectrum Diving and
Life Support Systems

Special Warfare
Maritime Mobility

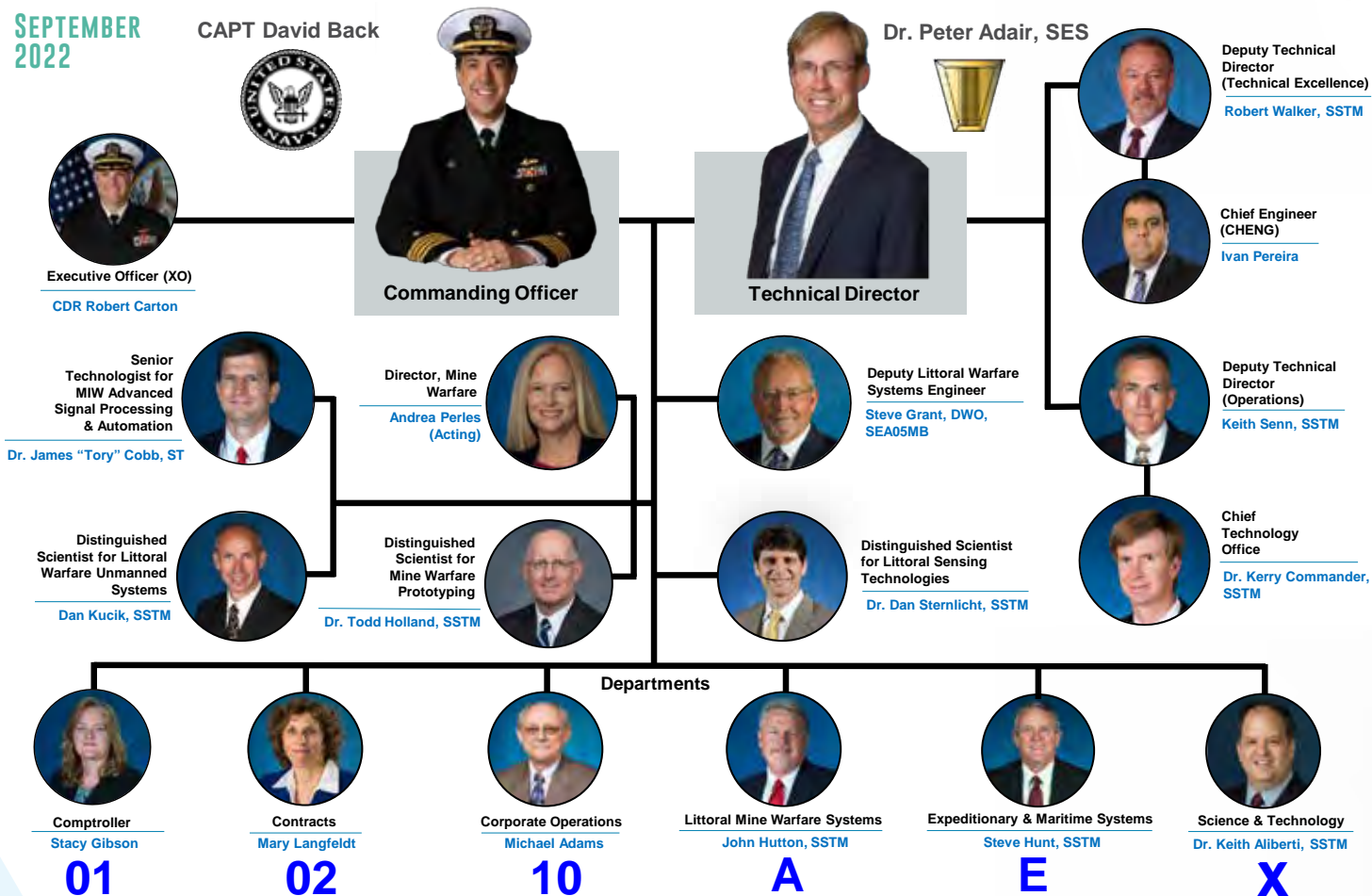
Littoral Mission Systems
Integration to include UxS

Joint Gulf Test Range: open
ocean, bays, estuaries,
rivers, & harbors

COMMAND LEADERSHIP

NSWC PCD Leadership

SEPTEMBER
2022



NEW
LEADERSHIP
IN FY23

NAME	CODE	TITLE
LT Rich Morales	XO	Executive Officer
Tommy Chatman	02T	Technical Acquisition Office
Dr. Jaimie Brock	10	Head, Corporate Operations Department
Kimberly Ten Broeck	10B	Deputy, Corporate Operations Department
Carmen Ferrer	1023	Environmental Branch
Stacy Faison	104B	Deputy, Activity Command Information Officer/Information Technology Division
Chris Weller	1053	Special Programs Branch
Dr. Gretchen Rivera	1062	ERP Extended Business Office Branch

NSWC PANAMA CITY DIVISION LEADERSHIP

NOVEMBER
2023



DEPARTMENTS



01 Stacy Gibson
Comptroller



02 Mary Langfeldt
Contracts



10 Dr. Jaimie Brock
Corporate Operations



A Kevin Oakes, SSTM
Littoral & Mine
Warfare Systems



E Steve Hunt, SSTM
Expeditionary &
Maritime Systems



X Dr. Todd Holland, SSTM
Science & Technology

NAME	CODE	TITLE
Dr. Gretchen Rivera	1063	Metrics, Analysis & Data Calls Branch
Kevin Oakes	A	Head, Littoral & Mine Warfare Systems Department
Jenny Howell	E	Deputy, Expeditionary & Maritime Systems Department
Stephen Howell	E25	Expeditionary Command & Control Branch
Robert Moore	E30	Expeditionary Systems Division
Peter Halvorson	E50	Integrated Logistics Division
Peter Romaine	X11	Littoral Acoustics & Target Physics Branch
Carrie Delcomyn	X12	Intelligent Sensing & Irregular Warfare Branch
Forrest Ferrell	X15	Threat Analysis Branch

STRATEGIC PLANNING

Strategic planning is vital to ensuring NSWC PCD remains postured to support the warfighter today and in the future. Over the course of FY23, OOX and the command's senior leadership worked through the strategic planning process to identify how we can best counter the threats facing the Navy. Through a series of strategy workshops, OOX and the command's senior leadership developed the organization's new vision and strategic objectives that will be the command's north star for investments, resource planning, and informing the workforce where the command is headed.



Stefanie Barron
Strategic Analyst



Danielle Kinkade
Corporate Strategist



Lisa Tindell
Command Strategist

STRATEGIC PLANNING LEADS

By using unique resources and expertise, the team defined what steps are needed to make the command's vision a reality. This entire campaign is captured in our new vision -- "Delivering relevant solutions in the littorals from seabed to space: For Today, Tomorrow, and the Navy after Next" -- (or "Dominate the Littorals" for short) and our new strategic objectives.

We also revisited our Core Values and decided it is in the best interest of the command to align with the Dept. of the Navy's Core Values of Honor, Courage, and Commitment.

Guiding principles were developed to codify the Panama City way of doing business. Together with the Navy Core Values, the guiding principles will direct day-to-day conduct and decision-making.

Having celebrated 78 years of warfighter and fleet support at NSWC PCD, this Strategic Plan will set us on a course to ensure relevancy for another 78 years from now.

NAVAL SURFACE WARFARE CENTER PANAMA CITY DIVISION

VISION

*Delivering relevant solutions in the littorals from seabed to space:
For Today, Tomorrow, and the Navy after Next*



MISSION

The mission of NSWC, Panama City Division is to conduct research, development, test and evaluation, and in-service support of mine warfare systems, mines, naval special warfare systems, diving and life support systems, amphibious and expeditionary maneuver warfare systems, and other missions that occur primarily in coastal (littoral) regions, and execute other responsibilities as assigned by Commander, Naval Surface Warfare Center.

CORE VALUES

HONOR

COURAGE

COMMITMENT



GUIDING PRINCIPLES: *WE ARE COMMITTED TO...*

**Serving the
Nation,
Warfighter
and the
Mission**

**Operating
as a
Unified
Team**

**Caring for
Our People**

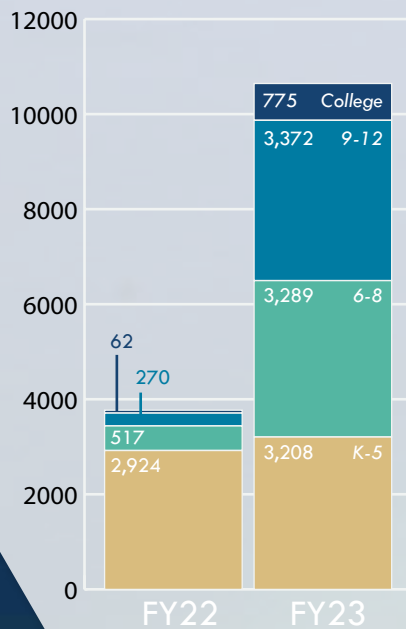
**Learning
and
Growing**

**Working
Smarter,
Not Harder**

STEM PROGRAM OUTREACH

NSWC PCD STEM OUTREACH

number of Students by Grade Levels



10,600+
students

1 659 Parents
1 134 Educators

Engagement Hours

40+ NSWC PCD civilian
and uniformed Navy
employees participated
in 50+ events

Over 2,000 employee
hours in support of
STEM activities



COLLEGE/UNIVERSITY OUTREACH

Educational Partnership Agreements (EPAs)

University of West Florida	SeaPerch Competition
Florida State University (FSU) Panama City	3D Print Materials Testing
Univeristy of Florida (UF)	FSU SeaPerch Competition

Student Competitions

RoboBoat, RoboSub, RobotX, Human Powered Sub
Carnegie Mellon, Massachusetts Institute of Technology, Embry–Riddle Aeronautical University, Cornell, UF, Georgia Institute of Technology, University of Michigan, University of Maryland, Oklahoma State University, University of Puerto Rico

Research Opportunities: NEEC, NURP

Florida Atlantic University Naval Undersea Research Program (NURP) Proposal Submitted	Dr. Tye Langston Dan Cassidy
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(NSWC PCD - \$60K / FAU - \$75K)

College/Department Advisory Councils

Florida A&M University-FSU ME	Dr. Damion Dunlap
FAU	Jeremiah Mandello Dr. Tye Langston

Senior Capstone Design

FAMU-FSU	RoboBoat – 4 Mechanical Engineers, 3 Electrical Engineers (5 FSU / 2 FAMU)
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NEW FY24 ACTIVITIES:

Student Conferences:

Becoming Everything You Are (BEYA) STEM Conference, American Society for Engineering Education (ASEE) Capstone Design Conference

Student Clubs & Organizations:

Society of Military Engineers, National Society of Black Engineers, Institute of Electrical and Electronics Engineers, American Society of Mechanical Engineers, Society of Women Engineers, Association of or Computing Machinery

SIGNIFICANT PARTNERSHIPS



BROWN UNIVERSITY

A significant test event took place in the Human Systems Integration (HSI) laboratory at NSWC PCD under a cooperative research and development agreement (CRADA) between NSWC PCD and Brown University. Under the CRADA, entitled “Development of Improved Sensor Systems and Algorithms Optimal for use in Brain and Spine Injury Research Associated with the high-speed craft (HSC) Environment.” NSWC PCD subject matter experts in Human Factors Engineering, Impact Injury Research and Development of Human Worn Instrumentation collaborated with a team of scientists from Brown’s PANTHER (Physics-based Neutralization of Threats to Human tissues and organs) and TIGER (Towards Injury prediction using G-sensor-based strain Estimation and motion Reproduction) teams to test Brown’s Accelo-Suit. This experiment was very valuable in that it allowed researchers from very different fields of study to come together with a similar mission, which is to protect HSC operators from injuries related to environmental conditions.



PORTSMOUTH NAVAL SHIPYARD AND RADIATION SAFETY & CONTROL SERVICES

In FY22, a three-way CRADA with NSWC PCD, Portsmouth Naval Shipyard (PNSY), and Radiation Safety and Control Services (RSCS) was signed into place to support the Autonomous Dry Dock Survey System (ADDS).

In 2019, NSWC PCD developed an unmanned ground vehicle to support the Autonomous Dry Dock Survey System (ADDS) under a Director’s Cup competition at the lab. In FY23, engineers from NSWC PCD integrated the Surface Contamination Monitor (SCM) sensor from RSCS onto the vehicle and completed initial testing in September of 2023. This robotic system will provide significant cost savings to Navy of up to 450 man hours per dry dock, per year, and introduce artificial intelligence capabilities into naval shipyard environments.



SAGETECH AVIONICS

This CRADA, entitled the Unmanned Aircraft Systems (UAS) Collaborative Research Effort, aims to combine technology and reimagined design within this dynamic field using Identification Friend or Foe (IFF) capabilities. Gavin Taylor, NSWC PCD Expeditionary Systems Division engineer, highlights some of the benefits from this collaboration.

“This CRADA will afford us the opportunity to integrate UAS with unique technologies developed by Sagatech Avionics, Inc. This integration would add immediate value to any systems [we] would provide to the warfighter through Identification Friend or Foe (IFF) capabilities not usually included in small form-factor UAS’s,” said Taylor.

NSWC PCD is developing a low-cost expendable UAS with a novel deployment method. One of the targets is to provide an effective platform to support U.S. Navy objectives to expand the advantage.

QUALITY MANAGEMENT



2023 saw the creation and distribution of the Quality Magazine, available in both hard copy (printed) form or electronically on the new Quality Management Office (QMO) website. The magazine explains the importance of Quality at our command, as well as providing information on where to locate Quality related documentation, for inclusion in the various projects and programs they are working on.

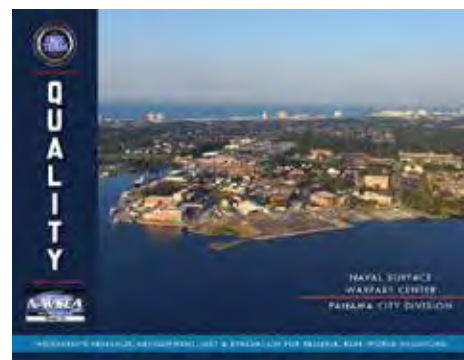
During the past year, the QMO conducted a successful series of audits of Code 10 business units including Equal Employment Opportunity Diversity and Inclusion Office, Security Office, and the Corporate Communication Office. Primarily, these pre-audits provided guidance and information for these offices to establish and build their own Quality Management Systems. A quality management system is vital to the success of the projects and programs conducted at NSWC PCD.

Code 00Q submitted the request for and received approval to extend the NAVSEA Safety and Regulatory Compliance Directorate Modernization Process approval letter of the NSWC PCD Quality Management System (QMS). The NSWC PCD QMS

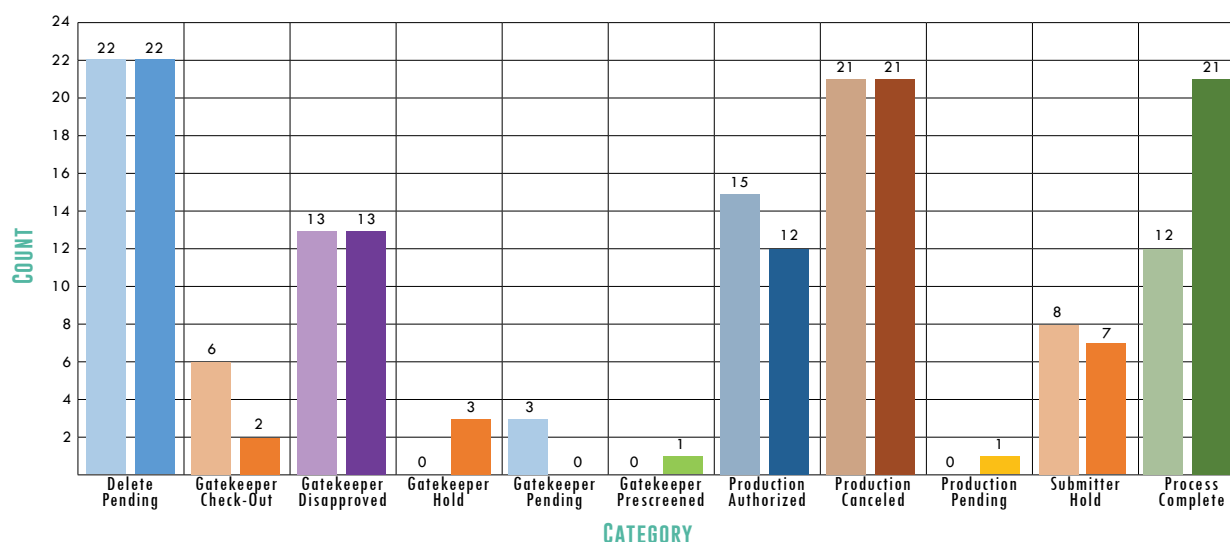
meets the current NAVSEA SI 009-004 and NAVSEA TS 9090-310 (series) requirements.

This extension allowed NSWC PCD to continue conducting Alteration Installation Teams (AITs) from our command in support of the fleet for the next three years. This will allow the organization to continue supporting the fleet by inserting and delivering our latest and greatest technology and capability.

Performed analysis of NSWC PCD's Shipboard Work AITs (which install equipment and software updates on ships, submarines, and other systems). On Time Delivery Metrics were further developed to provide recommendations for improvements and efficiency to the Chief Engineer Office and NSWC PCD AITs. This resulted in a significant increase in completed and closed out AITs.



COMMAND AIT FROM STATUS METRICS



CHENG

Chief Engineer (CHENG) Office

As part of executing the Competency Proficiency Program (CPP), the Project Management and Systems Engineering Competency Leads increased the number of Proficiency Review Boards held for candidates within their respective competency. Due to this success, the number of CPP Subject Matter Experts (SMEs) has increased throughout the command allowing for additional SMEs to mentor CPP candidates throughout the program. The continued increase of competency members attaining their proficiency levels validates our workforce's capability to successfully execute NSWC PCD's assigned tasks to deliver products and services to the warfighter.

In FY22, data visualizations were introduced as a pilot program with only three projects involved during our Mid-Year Execution Reviews (MERs). In FY23, the data visualization concept was fully transitioned to all projects throughout the command for use during Initial Baseline Reviews (IBRs) and MERs. Data visualizations allow for projects to view and present their financial, risk, and issue data at any time during the year for different stakeholder reviews. The visualizations not only capture data at the project level, but also at the Portfolio, Division, Department, and Command level by ingesting data from the authoritative data source and allows for filtering at the different levels in the organization. Data visualizations are currently in Tableau, but the CHENG's office is looking at different software packages for continued improvement in data visualization.

The CHENG's office created risk and issue management job aids to aid the workforce in using the command's risk/issue management tool. Additionally, the CHENG's office asked the project teams across the command to enter issues into the risk/issue management tool helping the command streamline efficiency. In the future, opportunities will be entered into the tool as part of implementing the DoD's Risk, Issue, and Opportunity guidance.



A DEPARTMENT

Littoral & Mine Warfare Systems Department

AUTOMATED TARGET RECOGNITION ON MINEHUNTING HELICOPTERS AND UNMANNED SURFACE VEHICLES

The AQS-24 Team completed fielding of the AN/AQS-24C Mine Hunting Sonar to the Helicopter Mine Countermeasures Squadrons and the MHU Detachment (Det). The AN/AQS-24C integrates a modular Volume Search Sonar (VSS) sensor suite to the existing Synthetic Aperture Side Looking Sonar (SLS) system. Concurrent with the system conversions, the team delivered improved Laser Line Scan sensors and two software revisions, the second of which incorporated the Automated Target Recognition (ATR) capability. For the HM community, the ATR presently resides in the Post Mission Analysis (PMA) computer reducing the mission analysis and target localization timeline. On the MHU, the ATR resides on the deployed platform. Future software revisions for the HM community will move the ATR onto the aircraft.

Coupled with the proven detection, classification, and identification capability of the AN/AQS-24C, the incorporation of the ATR technology significantly reduces the detect-to-engage timeline and fully meets the requirements of the Mine Warfare (MIW) sonar mission.



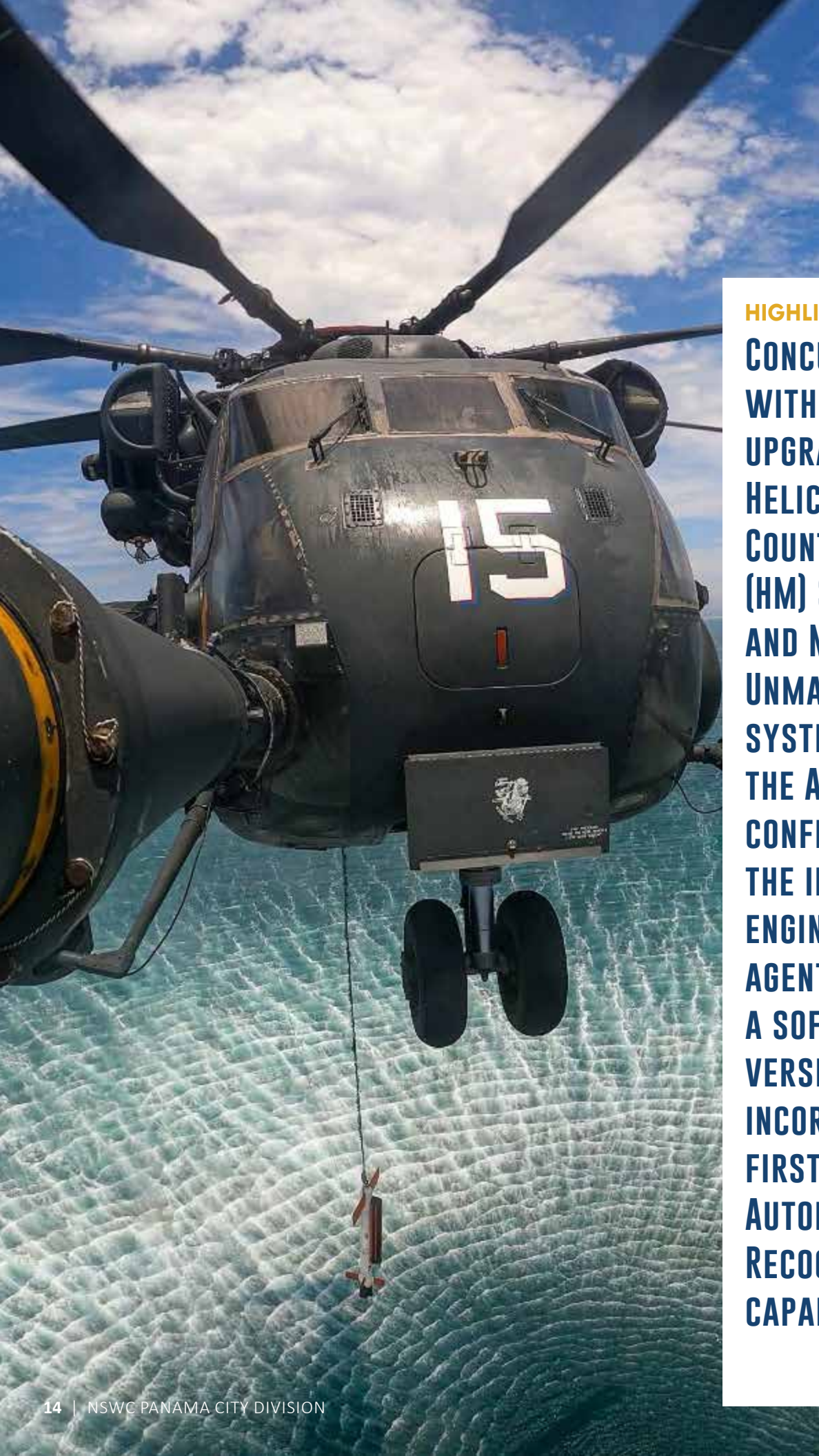
Mine Hunting Unit (MHU) Unmanned Surface Vehicle in transit with an AQS-24 mine hunting sonar.



AQS-24 launched from a Mine Hunting Unit (MHU) Unmanned Surface Vehicle.

Mine Hunting Unit (MHU) Unmanned Surface Vehicle in transit with an AQS-24 mine hunting sonar





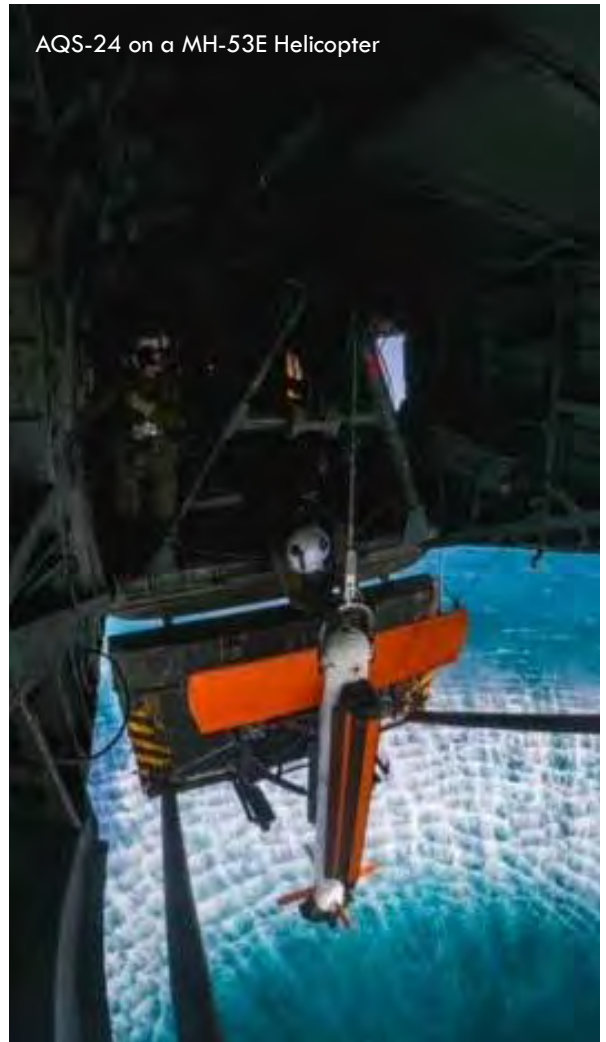
MH-53E streaming
AQS-24 Minehunting
sonar

HIGHLIGHT:

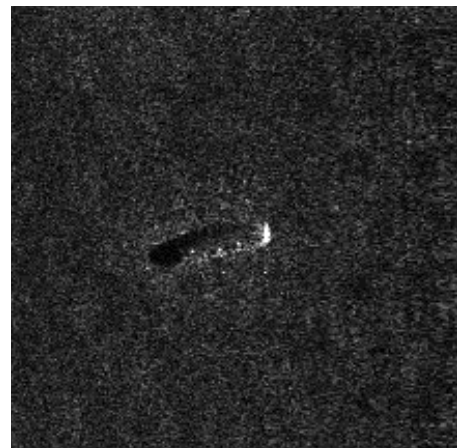
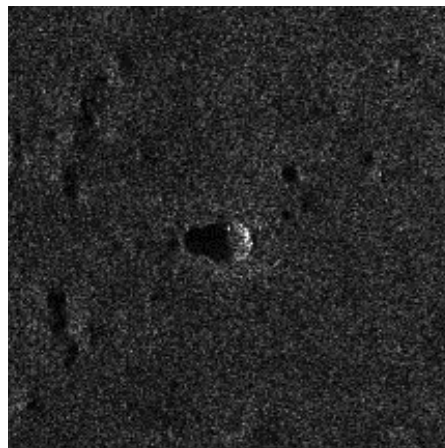
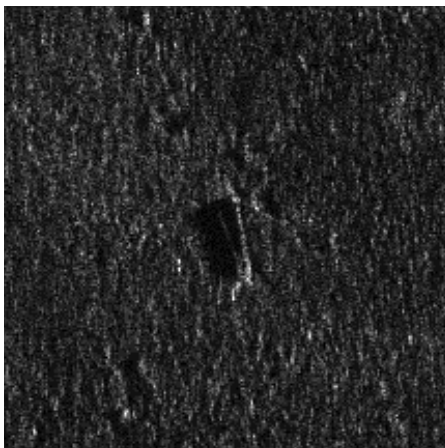
**CONCURRENT
WITH COMPLETING
UPGRADES OF ALL
HELICOPTER MINE
COUNTERMEASURES
(HM) SQUADRON
AND MINE HUNTING
UNMANNED (MHU)
SYSTEMS TO
THE AN/AQS-24C
CONFIGURATION,
THE IN-SERVICE
ENGINEERING
AGENT DELIVERED
A SOFTWARE
VERSION WHICH
INCORPORATES THE
FIRST OF ITS KIND
AUTOMATED TARGET
RECOGNITION (ATR)
CAPABILITY.**



AQS-24 on MHU being
deployed from a RFA
LSD(A) class ship



AQS-24 on a MH-53E Helicopter



ATR Calls on Objects of Interest



Watercraft Surface Tow Cradle and storage stand in the mission bay of the littoral combat ship

MINE COUNTERMEASURES MISSION PACKAGE COMPLETES INITIAL OPERATIONAL TEST & EVALUATION PHASE

The Mine Countermeasures Mission Package (MCM MP) completed several critical test events onboard LCS 20 (USS CINCINNATI) throughout FY22, including Buried Minehunting (BMH) Mission Module Integration Developmental Testing (DT), MCM USV+MH Technical Evaluation (TECHEVAL), and full MCM MP TECHEVAL events. These events culminated in the successful completion of MCM MP IOT&E conducted by LCS Mission Modules (PMS 420) and Operation Test and Evaluation Force (OPTEVFOR) in FY23, which demonstrated the entire detect-to-engage kill chain. The MCM Mission Package, as demonstrated, consists of the MH-60S helicopter, the MQ-8B unmanned aerial vehicle, the Coastal Battlefield Reconnaissance and Analysis (COBRA) near-shore mine detection system, the Airborne Laser Mine Detection System (ALMDS), the Airborne Mine Neutralization System (AMNS), the MCM Unmanned Surface Vehicle equipped with either the AQS-20 minehunting sonar or the Unmanned Influence Sweep System (UISS) minesweeping system, and the Knifefish surface mine countermeasures

unmanned underwater vehicle. Supporting systems developed by NSWC PCD include: the Multiple Vehicle Communications System (MVCS) – used to communicate & control our organic unmanned vehicles; Mission Package Application Software (MPAS) – encompasses all software used by the systems to communicate with the ship; Mission Package Computing Environment (MPCE) – computer assets utilized by MCM; and Surface Warfare (SUW) to provide connection to the ship; Mine Warfare and Environmental Decision Aids Library (MEDAL) – provides mine and mine warfare planning evaluation tools and databases; Net-Centric Sensor Analysis (NSAM) – post mission analysis tool and miscellaneous support equipment.

OPTEVFOR found the MCM MP operationally effective and suitable via demonstrated capability of all Key Performance Parameters (KPPs) and Key System Attributes (KSAs), paving the way for MCM MP Initial Operating Capability (IOC) Declaration and Fleet introduction in FY24.



MCM USV in the minehunt configuration proceeding to the operational test range

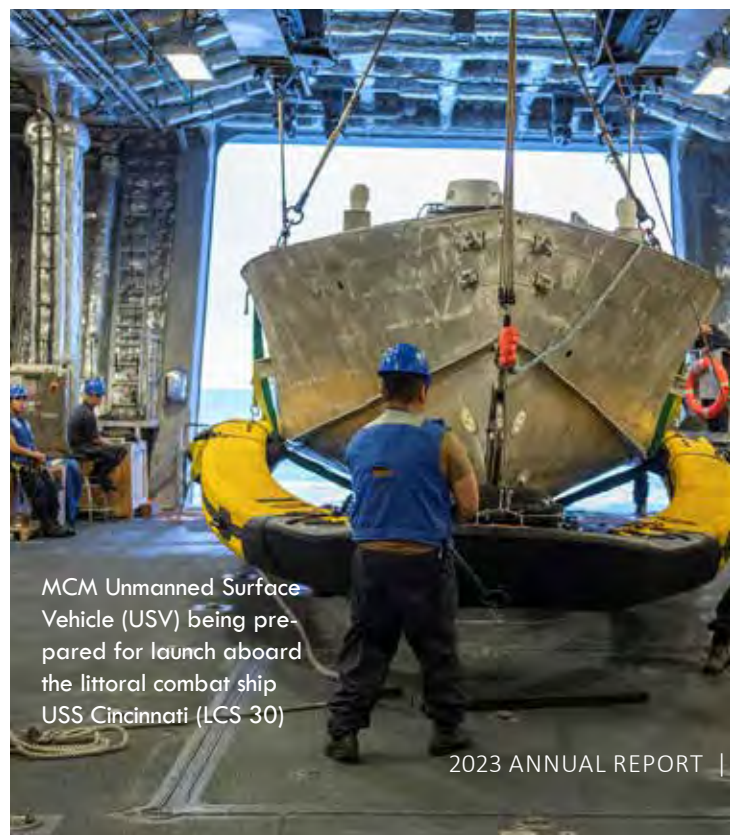


MCM USV being launched from the littoral combat ship



ALMDS installed on the MH-60S Knighthawk helicopter

HIGHLIGHT:
**THE MINE
 COUNTERMEASURES (MCM)
 MISSION PACKAGE (MP)
 SUCCESSFULLY COMPLETED
 INITIAL OPERATIONAL TEST
 AND EVALUATION (IOT&E)
 PHASE, DEMONSTRATING
 THE ENTIRE DETECT TO
 ENGAGE (DTE) KILL CHAIN.**



MCM Unmanned Surface Vehicle (USV) being prepared for launch aboard the littoral combat ship USS Cincinnati (LCS 30)

**THE ANALYSIS, TACTICS, & SIMULATION DIVISION
PROVIDED SUPPORT TO DIRECT FLEET REQUESTS
FOR ASSISTANCE IN VARIOUS AREAS OF MINE
COUNTERMEASURES (MCM) TO INCREASE FLEET
PROFICIENCY AND READINESS**

Several project teams from Code A40 provided support to direct fleet requests for assistance in various areas of MCM. The Underwater MCM (UMCM) Tactics team organized and executed training continuums to increase the proficiency of several EOD units and groups in MCM Commander (MCMC)-level operations. In addition, the team also executed certification exercises (CERTEX) that allowed several EOD units to certify for deployment. The Integrated Tactics team executed training continuums for MCMGRU 3, SMWDC, Commander Task Force (CTF) 52 and CTG 68.3 to provide staff members with knowledge on MCM tactics and theory, planning and evaluation of missions in integrated operations, as well as unit tasking and reporting. In addition, the team traveled to support the staffs in theater with planning and risk evaluation, as well as tasking and reporting to subordinate units, during exercises, such as Dynamic Move Exercise (DME), Baltic Operations (BALTOPS) and International Maritime Exercise (IMX). The MIREM team in collaboration with multiple representatives from various projects across the department, executed events to facilitate data collection in support of tactics, techniques and procedures validation, characterization of system capability, and experimentation. The teams collaborated, planned, and executed four major events in conjunction with several major exercises, IMX 2023, BALTOPS 2023 and 2JA that allowed data collection for systems, such as Costal Battlefield Reconnaissance and Analysis (COBRA), Single-system Multimission Airborne Mine Detection (SMAMD), MK18 Family of Systems (FoS) and Through-the-Sensor (TTS).

These efforts resulted in a dual impact. Externally, these efforts increased fleet readiness overall in MCM operations, prepared deploying units by increasing proficiency in MCM, and allowed NSWCCD to be recognized as the experts in MCM. Internally, the events allowed increased collaboration across the department, and allowed opportunities for data collection in support of system characterization.



Command and Control Structure for
International Maritime Exercise 2023



HIGHLIGHT:

NSWC PCD PROVIDED ESSENTIAL SUPPORT TO MANY FLEET COMMANDS, INCLUDING EXPLOSIVE ORDNANCE DISPOSAL (EOD) MOBILE UNITS 2, 5, 8, AND 11, HELICOPTER SEA COMBAT WEAPONS SCHOOL, ATLANTIC (HSCWSL), AND FLEET STAFFS, SUCH AS MINE COUNTERMEASURE (MCM) GROUP (MCMGRU) 3, NAVAL SURFACE AND MINE WARFIGHTING DEVELOPMENT CENTER (SMWDC), COMMANDER TASK GROUP (CTG) 68.3, THROUGH CERTIFICATION EXERCISES PRIOR TO DEPLOYMENT, TRAINING CONTINUUMS AND WARGAMES, EXERCISE PLANNING, EXECUTION AND REPORTING, AND THROUGH MINE WARFARE AND EFFECTIVENESS MEASURING (MIREM) DATA COLLECTION EVENTS.



Quickstrike ER deployed from aircraft



QUICKSTRIKE EXTENDED RANGE UNDERWATER MINE COMPLETES TESTING AT THE PACIFIC MISSILE RANGE IN HAWAII

The flight test event demonstrated the system's ability to place mines with precision from significantly increased standoff distance compared with current delivery capabilities. The objective of OD-4 was to validate the final iteration of the Operational Flight Program (OFP) Software used in QS-ER System guidance. Two QS-ER All-Up-Rounds (AUR) were released from a B-52H at altitudes greater than 30,000 ft. Both test assets successfully traveled to target location with impacts occurring within 0.5 meters of the desired target position.

The successful demonstration of QS-ER during OD-4 moves the system closer to completing the development phase and becoming a viable maritime mining option for the warfighter.

HIGHLIGHT:
**DURING FY23, THE
QUICKSTRIKE EXTENDED
RANGE TEAM (QS-ER)
SUCCESSFULLY
CONDUCTED OPERATIONAL
DEMONSTRATION 4 (OD-4)
AT THE PACIFIC MISSILE
RANGE FACILITY OFF THE
COAST OF KAUAI, HAWAII.**

JOINT DIRECT ATTACK MUNITION ASSAULT BREACHING SYSTEM COMPLETES FINAL TEST EVENT AGAINST ANTI-LANDING MINES

The mission of the Joint Direct Attack Munition (JDAM) Assault Breaching System (ABS) or (JABS) is to breach mines and obstacles in the surf zone (0-10 feet of water) and on the beach prior to an amphibious assault. JABS is a combination of 2000-lb guided bombs (MK 84 or BLU-117) paired with NSWC PCD's lethality database and mission planning software in MINEnet Tactical. The JABS program is a non-Acquisition Category (ACAT) effort that was started in the late 1990s during Office of Naval Research (ONR) technology evaluations for the mine countermeasures (MCM) mission in coastal regions. In 2006, JABS was formally selected as a non-material solution by the Joint Requirements Oversight Council (JROC) and assigned to the assault breaching mission via a Doctrine, Organization, Training, Material, Leadership and Education, Personnel, Facilities and Policy (DOTMLPF) change recommendation. Characterizing JABS performance against various mines and obstacles has been a collaborative effort between NSWC PCD, NSWC Indian Head Division, Eglin Air Force Base, and support contractors.

After three decades since the program's inception, the program reached a milestone by completing their final test event—characterizing JABS performance against a specific foreign anti-landing mine at an operationally relevant water depth—at Eglin AFB's shallow-water explosive test pond, Sept. 20, 2023. This was the final event in a long series of tests that characterized JABS performance against a range of mine types in different water and burial depths that landing forces may encounter. Without the test series, the fleet would have less confidence planning a breach against the full range of threat types and would either need to accept additional risk to the landing force or drop an excessive number of munitions to be confident the threats had been cleared.

Testing demonstrated capability, which will allow fleet users to maximize effectiveness of operations with use of a minimum number of assets, reducing cost and time.

Test team at the test pond, Eglin Air Force Base, Fla.





HIGHLIGHT:

**THE JOINT DIRECT ATTACK
MUNITION ASSAULT BREACHING
SYSTEM COMPLETES FINAL TEST
EVENT AGAINST ANTI-LANDING
MINES AT EGLIN AIR FORCE BASE.**

Joint Direct Attack Munition (JDAM) live
fire detonation, test pond, Eglin AFB, Fla.

E DEPARTMENT

Expeditionary & Maritime Systems Department

JOINT INTEROPERABILITY & IRREGULAR WARFARE DIVISION SHOWCASES WATERSIDE SYMPOSIUM

Members of E Department's Joint Interoperability and Irregular Warfare Division (E20) held a Waterside Symposium Technical Demonstration in April showcasing the new, leading-edge Navy Enterprise Tactical Command and Control (NETC2) design that the Navy Lab is developing. The Waterside Symposium took place at NSWC PCD detachment, a Joint Expeditionary Command and Control (JEXC2) test range.

NETC2 is part of the JEXC2 portfolio. The Shore and Expeditionary Integration Program Office (PMW 790) is the sponsor, and Naval Expeditionary Combat Command (NECC) was the main customer for this event. The symposium was designed to allow each of the NECC communications departments to see/experience the NETC2 design in action. Brian Snellen, NSWC PCD NETC2 project manager, described the equipment used in the demonstration.

"NSWC PCD used a PacStar baseband kit that will replace the existing Rapid Response Kit and NETC2(V)1 Systems. This new kit, called Expeditionary Deployable Network (EDN), was pulling services [email, voice, software] from the Navy Expeditionary Tactical Entry Point (NExTEP), which was designed and developed here at NSWC PCD in E20 to provide services directly to NECC units. NExTEP can host multiple NECC users and provide dedicated resources to those users during future missions," Snellen said. "During the Waterside Symposium, the users were able to view emails being sent, utilize chat for rapid internal conversations, and software downloads to demonstrate the system functionality. The event's final demonstration showed attendees the technology that will integrate with the Expeditionary Carry-On (ExCON) 2.0 solution, another NSWC PCD designed and developed capability for afloat command and control on the move."



NETC2 equipment demonstrated at the Waterside Symposium: front and center (tan), a Hawkeye 4 Lite satellite terminal, back, left (white) a Copasat Storm satellite terminal.



(left to right) Chief Warrant Officer Three Alison Czuhajewski, Navy Expeditionary Combat Command, and Micah Gomez, Joint Expeditionary Command and Control (JEXC2) participate in The Waterside Symposium held at NSW PCD detachment, a JEXC2 test range, April 5.

The NECC N6 captain had a vision to demonstrate new technologies to his subordinate commands. Snellen arranged and coordinated the event and invited members from NECC and PMW 790 to attend, including both explosive ordnance disposal commodores and all their respective commanding officers as distinguished visitors.

“The end goal of this event was to gain input from the different N6 commands that will allow NSW PCD to develop a better product for the warfighter,” said Snellen. “This is the future vision of how NECC will fight and NSW PCD is the main integrator for the NETC2 Family of Systems. This will enable NSW PCD to rapidly deliver this solution to the warfighter and ensure warfighting dominance.”

**“THIS IS THE FUTURE
VISION OF HOW NECC
WILL FIGHT AND
NSWC PCD IS THE
MAIN INTEGRATOR FOR
THE NETC2 FAMILY OF
SYSTEMS.”**

NSWC PCD NETC2 project manager



Divers Augmented Vision Display (DAVD) images

MARITIME MISSION SYSTEMS DIVISION CONTINUES TO EXCEL AS NAVY'S TOP DIVING EXPERTS

Diving Research and Capability Acquisition

The team executed a key Memorandum of Agreement (MOA) between NSWC PCD and the National Telecommunications and Information Administration to enable our experts to collaborate with and share audio recordings used to evaluate the intelligibility of diving communication systems focused on helium-based gas mixes. This cooperative research has the potential to improve diver communication and intelligibility between the diver and topside.

Through the Diver Extreme Environment Protection (DEEP) project, the team developed an innovative wetsuit layering technology that has been proven to improve thermal capabilities for a diver at depth. Once the full wetsuit is complete, the new technology will give the Navy diver the ability to stay on deeper mission for a longer duration without thermal comfort limiting the dive.

Using Naval Innovative Science and Engineering (NISE) funding, E10 studied and tested various diving communications commercial prototype technologies. This research and testing focused on multiple diving helmet noise mitigation and communication enhancement technologies. Findings from this effort have been conveyed to cooperative research and development industry partners resulting in better understanding of the specific issues affecting communication clarity and excessive noise sources within the breathing loop of dive equipment.



An array of E10's various diving and life support equipment to include Diver Integrated Modular System of Systems (DIMISS), Electric Resistive Active Thermal System (ERATS), and Diver Extreme Environment Protection (DEEP).



Diver Propulsion support for Special Operations Command

System Sustainment

Teams across all diving projects completed planned maintenance, overhaul, product improvement, and/or testing of numerous diving systems, including underwater breathing apparatuses (UBAs), gas supply equipment, navigation systems, etc.

The NSW PCD Fleet Diving In-Service Engineering Agent (ISEA) established the Divers Augmented Vision Display (DAVD) Depot. The depot is responsible for DAVD inventory management, equipment repairs, fleet delivery, and training.

The team established a magnetic screening capability at NSW PCD to allow for rescreen of repaired units and parts instead of requiring them to be shipped and labeled by Naval Surface Warfare Center Indian Head Explosive Ordnance Disposal Technology Division (NSWC IHEODTD).



Magnetic Screening Capability

TEST & EVALUATION AND PROTOTYPING DIVISION SUPPORTS KEY NAVY PROGRAMS

Though E40's efforts on any number of projects are worthy of being highlighted, two projects funded by Naval Innovative Science and Engineering (NISE) funds in E Department stand out. For these projects, the E40 team worked closely with the design teams, and drove design changes based on testing results. In both instances, the accessibility of NSWC PCD test ranges (including airspace) was paramount in enabling each project's Research, Development, Test & Evaluation (RDT&E) activities.

Advanced Autonomous Remote Life-Saving System (AARLSS)

From May to September, E40 personnel led an iterative progression of NISE Developmental Tests for AARLSS. AARLSS is a rapidly deployable, unmanned surface vehicle (USV) that increases probability of rescue during man-overboard and other emergency situations with personnel in the water (PIW), such as a downed pilot scenario. The system is centered on an NSWC PCD-designed sensor and software package that is integrated with a commercial-off-the shelf USV platform. This combination of software and hardware

enables AARLSS to detect, identify, and classify PIW, navigate towards successfully classified PIW targets, and serve as a floatation device until rescuers arrive. AARLSS can navigate via remote control or conduct autonomous search patterns.

AARLSS testing began with initial on-water checkouts such as buoyancy, stability, and propulsion testing, then proceeded to computer vision system testing that characterized AARLSS's object detection algorithm. Following the incorporation of test-driven design changes, FY23 NISE Developmental testing culminated in the successful demonstration of AARLSS's autonomous, waypoint-initiated search capabilities while concurrently running its object detection algorithm. This accomplishment was essential in preparing AARLSS for participation as the USV node in Q1 FY24 Joint Autonomous Remote Vehicle Integration System (JARVIS) testing, which was a Commander in Chief – U.S. Pacific Fleet (CINCPACFLT) initiated demonstration that showcased the ability to enhance communications between and task unmanned vehicles in multiple domains (air, surface, and subsurface).

AARLSS-1 and AARLSS-2 operating in the St. Andrew Bay Test Range for the JARVIS Demonstration



Winged Zone Agnostic Reconnaissance Drone (WIZARD)

In June, E40 led developmental testing of the WIZARD, a NISE project which intends to provide expeditionary forces with a low-cost, rapidly deployable, unmanned aerial system (UAS) that is suited for high-endurance intelligence, surveillance, and reconnaissance missions such that expeditionary forces can define the forward battle landscape using passive or low-emitting sensors.

The FY22 WIZARD configuration was centered on a novel, inflatable wing. However, manufacturing a reliable, inflatable wing proved to be unrealistic for the given timeframe and budget. Instead, in FY23, the E40-led design team explored design alternatives and decided to pursue an expandable wing that uses light-weight parachute material and generates lift in a similar manner to a hang-glider.

After a June consultation with UAS locker to attain the requisite flight clearances, E40 personnel led NISE Developmental Tests supporting initial flight checkouts of WIZARD's novel wing technology at NSWC PCD's Non-Magnetic Test Area (NMTA). Two UAS launches were attempted, and the second launch saw slightly more hang time than the first. However, the parasitic weight of the NiMH battery powering the system prevented WIZARD from achieving sustained flight. Despite this short hang time, it was evident that the novel expandable wing design experienced air flow that caused the wing to resemble that of a bird or a hang glider in stable flight. This low-level validation indicates the potential for success pending the incorporation of a modern battery that can generate sufficient power needed to sustain flight.



WIZARD Launch #2 during Fixed-Wing Flight Testing at the Non-Magnetic Test Area (NMTA)

X DEPARTMENT

Science & Technology

ACOUSTIC COMMUNICATIONS – MODELING & SIMULATION

Many automated underwater systems and vehicles rely on acoustic communications to receive commands and transmit mission data back to the user. Unfortunately, acoustic communication links tend to be slow and are prone to dropping out, due to the complexity of the underwater acoustic channel. Having tools available to simulate acoustic communication links will allow for better pre-mission analysis of communications systems and development of next generation high-speed communications.

A suite of signal processing routines has been implemented into the Modular Acoustic Simulation Toolset of the Department of the Navy (MASTODON) for simulating underwater acoustic communications. These routines are used to generate waveforms corresponding to commonly used modulation schemes and are currently being validated against commercial modem designs. The generated waveforms are passed

through MASTODON, which generates a simulated acoustic channel to produce the expected waveform at the receiving modem. Our modem emulation routines then attempt to demodulate the output waveforms to test whether the transmitted information can be successfully received in each environment.

These tools allow users to load in each bathymetry and other environmental parameters to create a simulated environment of where a set of acoustic modems are intended to be used. The user can then test different modem configurations to determine what configuration may work best in each environment, such as projector and receiver beam patterns, position, transmit power, and modulation schemes or modem model. This pre-mission analysis is expected to help users to select modems and communications systems tailored to specific use cases rather than trying to find blanket solutions that may not work well in the desired environment.

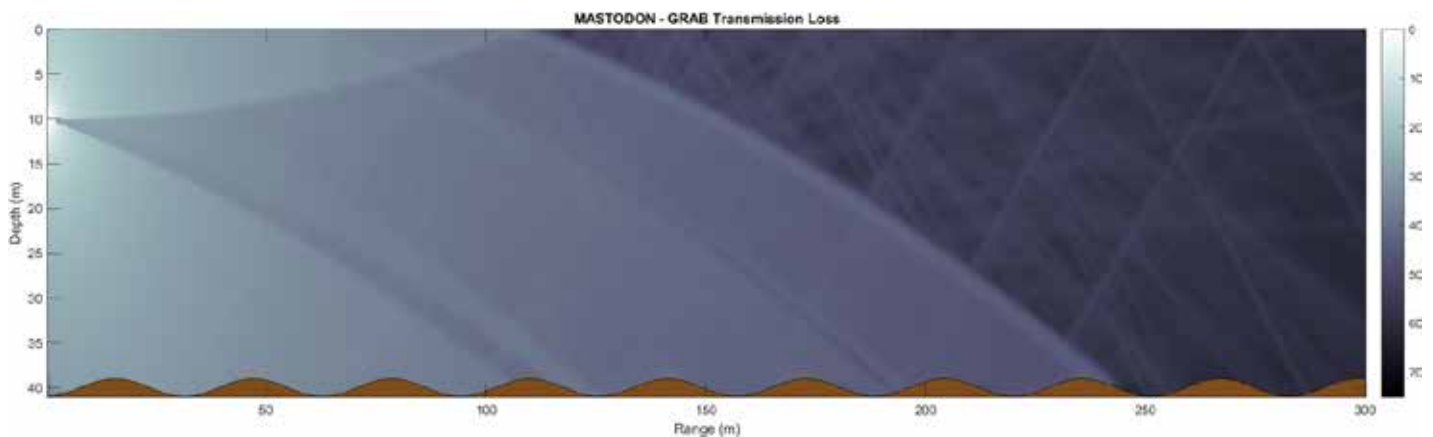


Figure 1. Transmission loss plot of a simple channel with a rippled bottom and an exaggerated sound speed profile generated by MASTODON. This plot illustrates both the refraction and scattering of sound through the underwater channel.

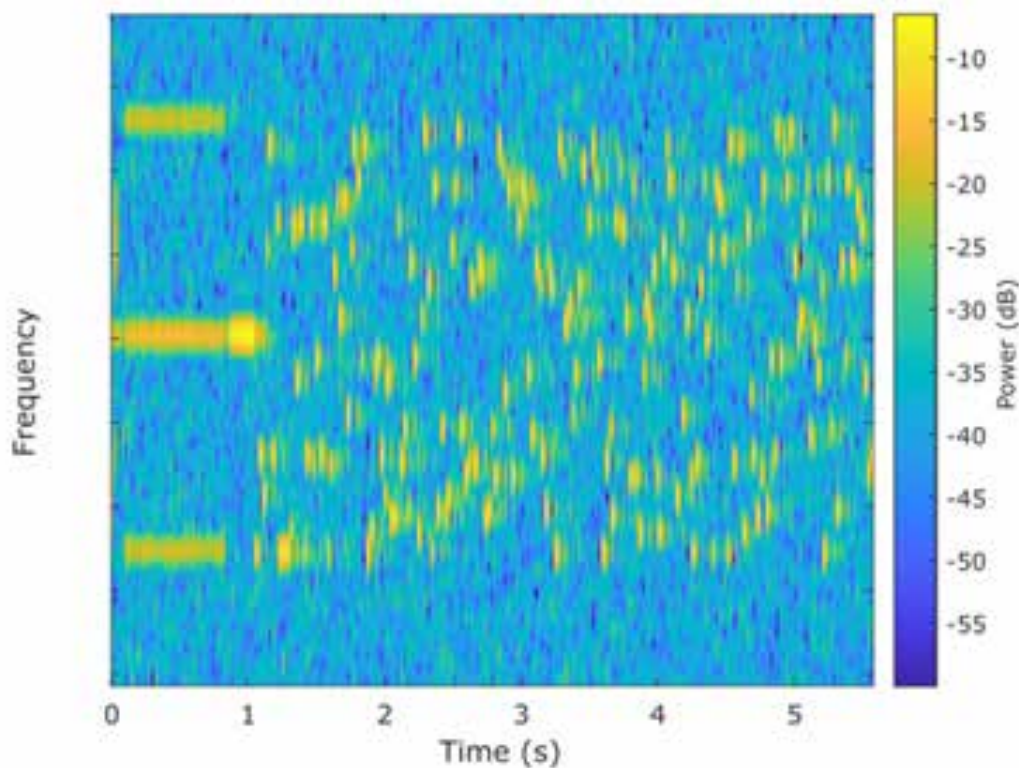


Figure 2. An example communication waveform using 64-tone Multiple frequency-shift keying (MFSK) after being sent through the simulated acoustic channel. Note the introduction of noise and smearing of the individual tones due to multi-path effects.

These tools can also help more advanced users to develop their own modulation schemes tailored to specific use cases. Many of the signal processing routines have been designed in a generic way and can be reconfigured for novel modulation schemes and specialized error correction techniques. The need for high-data rate and covert underwater links is helping to drive the search for new modulation schemes and having access to acoustic communication simulation tools is necessary for their continued development.

HIGHLIGHT:
IN FY23, X DEPARTMENT'S SENSING SCIENCES & SYSTEMS DIVISION DEVELOPED A SUITE OF SIMULATION TOOLS FOR THE IMPROVEMENT AND PERFORMANCE ANALYSIS OF BOTH EXISTING AND NEXT GENERATION UNDERWATER ACOUSTIC COMMUNICATION SYSTEMS.

USING BIOTECHNOLOGY TO DEVELOP NOVEL MATERIALS FOR NAVAL APPLICATIONS

HIGHLIGHT:

X DEPARTMENT'S BIOTECHNOLOGY RESEARCH & DEVELOPMENT LABORATORY (BRDL) IN THE INTELLIGENT SENSING & IRREGULAR WARFARE BRANCH) FOCUSES ON THE ADVANCEMENT OF SPECIAL MATERIALS FOR NEW MARITIME SYSTEMS CAPABILITIES THROUGH MULTIPLE SPONSORED EFFORTS.

- ★ Synthetic marine biodegradable protein material produced from microbial fermentation for non-lethal harbor and port defense
- ★ Characterization of innovative biomimetic materials for adaptability in dynamic environments
- ★ Biodegradable plastics with tunable lifespans for Unmanned Underwater Vehicles (UUVs) and hydrophone construction
- ★ 3D printable circuit boards for underwater environments
- ★ Protective coatings and materials treatments for naval equipment and assets

The Department of Defense (DoD) has identified biotechnology as a Critical Technology Area that will significantly impact the world around us and the character of the battlefield. Biotechnology is an interdisciplinary field that uses living systems, such as bacteria and fungi, to produce a wide range of products and technologies for various applications. Microorganisms are genetically modified so that they become cellular factories of desired molecules like proteins, antibiotics, or fuels that can then be purified and characterized. These bioprocesses are cleaner, greener, and more efficient than historical methods of production and are growing in popularity as the tools of the trade become cheaper and easier to use. Biotechnology will strengthen the domestic supply chain, allow development of new materials with novel properties, and provide point-of-need manufacturing for building and energy resources and production.

The NSWC PCD BRDL is making significant contributions to the field with innovative materials development for nonlethal harbor and port security applications, operational effectiveness in contaminated or extreme environments, and biodegradable UUV construction. Recent work by the BRDL team utilizes state-of-the-art chemical and biological analysis and characterization equipment to mimic natural materials, such as gecko feet or mussel adhesives, and identify their molecular composition. From there, the team uses bioinformatics,

Inspiration from Nature

Figure 1. Development steps the BRDL team uses to develop novel recombinant protein fibers that mimic behaviors of natural hagfish slime.

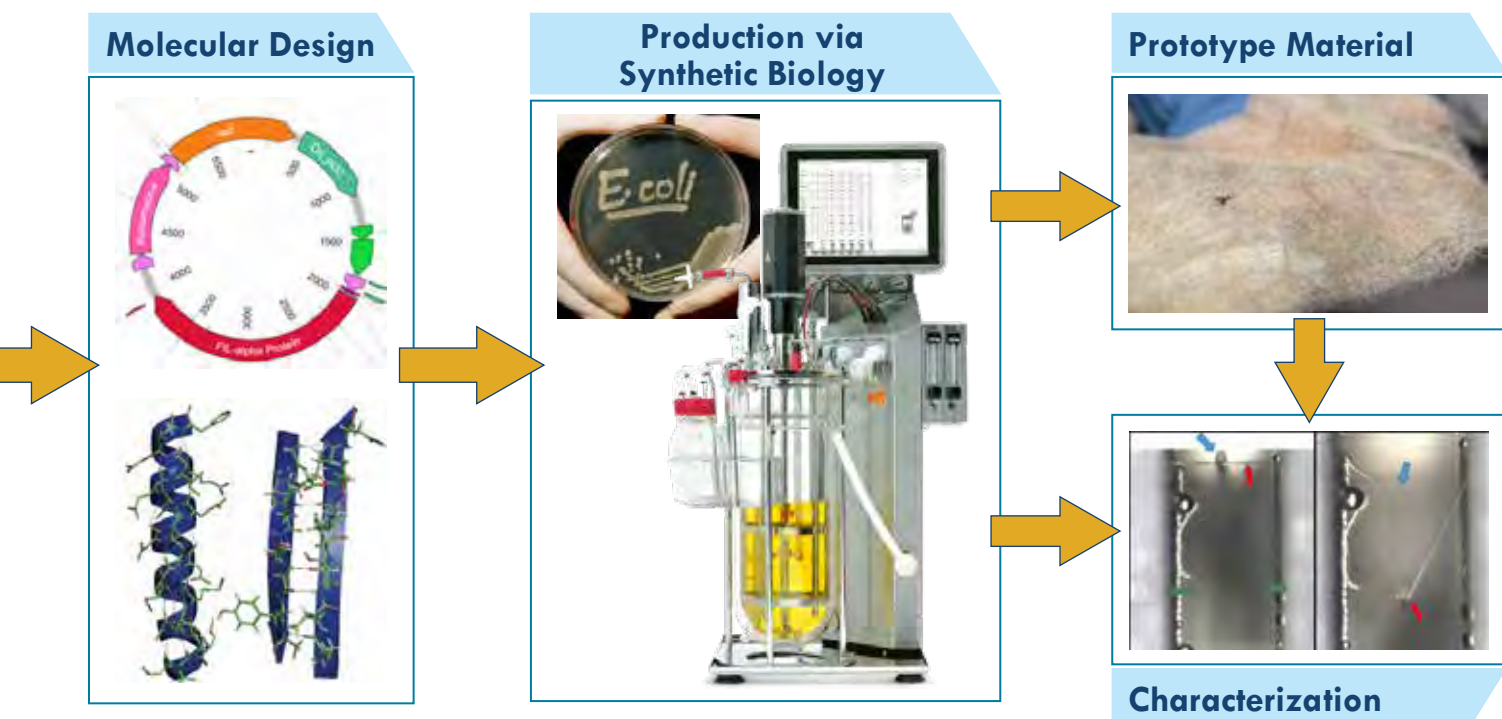


genetic manipulation, and microbial fermentation to produce synthetic versions of these molecules (Figure 1). Additionally, the BRDL team explores how the environment influences and interacts with common commercial-off-the-shelf (COTS) materials and takes advantage of these interactions to develop new solutions for the warfighter.

NSWC PCD is leading the charge to evolve new operational applications resulting from DoD investments in biotechnology in support of maritime systems, enhanced diving, littoral irregular warfare, and coastal defense. The team has a portfolio of research projects, but one example of biotechnological innovation at NSWC PCD is the development of synthetic recombinant proteins based on the natural material from hagfish. These proteins form a fiber that has unique properties over common petroleum-based textile fibers. The team works with academic and industry partners to patent the technology and increase its biomanufacturing viability. One breakthrough the team discovered using artificial intelligence (AI) modeling simulation software was that specific sections of the protein aid in the alignment of helical rods. Thus, by optimizing the amino acid sequence from the natural hagfish protein, the team developed a protein that shows a higher degree of alignment that may lead to an increase in the mechanical properties of the synthetic fiber.

The team has increased hagfish protein production from small, lab scale fermentation to pilot scale production to enable several successful testing events. As production becomes routine, costs will decrease, and further testing will become easier and more frequent. The group also produced patents for biodegradable hydrophones and created tunable 3D printing filaments for UUV construction. Further development of these material solutions will assist in providing irregular and littoral warfare capabilities.

Biotechnology is currently converging with other disciplines, such as AI and automation, to fuel a wave of rapid innovation that is transforming the world around us and changing the character of the battlefield. As biotechnology becomes more accessible and widespread, it creates new demands and vulnerabilities for the DoD as competitors seek to use this emerging field to gain a first adaptor advantage. The potential for this field to reduce logistical burden, lessen sustainment costs, increase energy efficiency, and create innovative products and materials for a wide range of capabilities over the next few decades is why the DoD identifies biotechnology as one of the top modernization priorities. NSWC PCD is well positioned to lead the Navy forward on this transformative innovation topic.



SURFACE SHIP BUBBLY WAKE MODELING

Surface ships have signatures, which enable a ship to be tracked. One such signature is the bubbly wake left as the ship traverses the water. Each wake differs, due to ship size, design, speed, and environmental factors. The theory developed in studying bubbly wakes can be used to assess vulnerabilities of ships and their respective wakes that are easily identified and tracked. Armed with this knowledge, designers can develop counter measures to any apparent signature, which are several kilometers long for surface ships. However, due to computational complexity, underlying assumptions have hindered the consideration of more realistic scenarios. As there has been considerable progress on the computation of bubbly flows, this effort's goal is to take advantage of these computational advancements and develop and validate a code capable of computing a far field wake during additional ship maneuvers and sea states.

While the science of bubbly wakes is reasonably understood, computational complexity has hindered the advancement of modeling until now. The length of ship wakes coupled with the orders of magnitude smaller fluid motions that need to be resolved resulted in simulations that were not computationally possible. Thus, simplifying assumptions were made in existing models to reduce the computational burden of more complex scenarios. For example, current simulations are relegated to making predictions for only straight steady courses in calm seas, implying that steady state numerical modeling limitations prevent transient ship maneuvers from being simulated. These limitations produce symmetric wakes, which are not relevant for many conditions encountered.

HIGHLIGHT:

X DEPARTMENT'S THE UNMANNED SYSTEMS, AUTOMATION & PROCESSING DIVISION, MADE SIGNIFICANT PROGRESS IN THE EFFORT TO MODEL FAR FIELD WAKE DURING MORE COMPLEX SHIP MANEUVERS AND SEA STATES:

- ★ Incorporated additional ship maneuvers and sea states into software model
- ★ Applied recent computation advancements in far field wake
- ★ Validated initial approach
- ★ Continued validation with existing in-water ship data and sea state induced ambient bubble populations

Faster and larger computations are now possible with new computational fluid dynamics methods enabling the lifting of the steady assumptions allowing transient conditions to be simulated. Over the past several years with funding from Office of Naval Research (ONR) and in collaboration with the University of Iowa, a new method of computation has been established. Testing of the new methods have resulted in simulations of the far wake in sea state conditions, accelerations, and ship maneuvers. (See Figure 1.) The added environmental conditions have resulted in more realistic non-symmetric wakes representative of in-water test data.

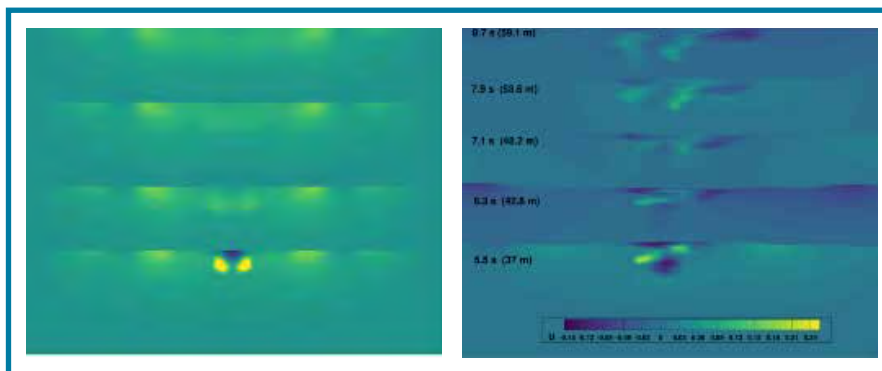


Figure 1:
Current (left)
and enhanced
(right) simulation
results.



Figure 3. Heron USV searching for red handle to recover DREWUV

HIGHLIGHT:

WORKING UNDER THE LITTORAL WARFARE INNOVATION CELL (LWIC), X DEPARTMENT INTERNS WITH OVERSITE BY RESEARCHERS COMPLETED A MAJOR MILESTONE IN THE DEVELOPMENT OF TECHNOLOGY THAT WILL ENABLE FUTURE HETEROGENEOUS SWARM DEVELOPMENT. IN FY23, A LOW-COST MOBILE GATEWAY BUOY THAT WILL ALLOW FOR AUTONOMOUS COMMAND AND CONTROL OF VEHICLE ASSETS BY OTHER ASSETS WAS DEVELOPED AND PROTOTYPED OVER SHORT TIME FRAMES. WHILE THE INITIAL CONCEPT INCLUDES RUDIMENTARY FUNCTIONS SUCH AS TRACKING AND COMMAND AND CONTROL, MORE ADVANCED AUTONOMY BEHAVIORS WILL BE DEVELOPED IN THE FUTURE THAT WILL ENABLE SCALED-SWARMING BEHAVIORS CONSISTING OF VARIOUS SURFACE AND SUBSURFACE ASSETS FOR MISSION-FOCUSED GOALS SUPPORTING A WIDE RANGE OF MISSIONS INCLUDING MINING AND MINE COUNTERMEASURES (MCM).

DEVELOPMENTS OF A UUV LAUNCH/RECOVERY SYSTEM AND A LOW-COST MOBILE GATEWAY BUOY APPLICATIONS

Using support from LWIC during the summers of FY22 and FY23, the research consisted of designing and developing low-level components, both physical and software in nature to support collaborative autonomy development that will enable more swarming research. To facilitate this work, LWIC utilizes a fleet of vehicles including two Clearpath Heron Unmanned Surface Vessels (USV), shown in Figure 1, and four Disposable/Reusable Exploratory Warfare Uncrewed Vehicles (DREWUV).

In FY22, the focus of work was to design and implement a mechanism by which one could operate two DREWUVs from a Heron USV, including launch/recovery and communications to resolve difficulties associated with using larger manned vessels for UUV operation. This work demonstrated the successful launch of two DREWUVs from the Heron USV and made progress on recovery using a camera to detect the color of the DREWUV handle and localize it for recovery, shown in Figure 2 and 3.

For FY23, a low-cost mobile gateway buoy utilizing a Heron USV as a gateway was developed to provide constant communication between vehicle operators and underway UUVs. The interns with oversight by

Figure 1. Heron USV with UUV launch and recovery cage.



NSWC PCD researchers designed and built the buoy, which is a major component necessary to facilitate communications within future swarming fleets. This development marks the culmination of two years of research and development that will enable advanced swarm behavior research with applications to both mining and MCM missions.

With the support of ONR and LWIC, this program has developed important components to assist with swarming research - where this system of USV and UUVs will go on to support science and technology developments for future ONR projects for the next couple of years. Additionally, our research group has been improved by workforce development by supporting many intern students who may be hired in the coming years.

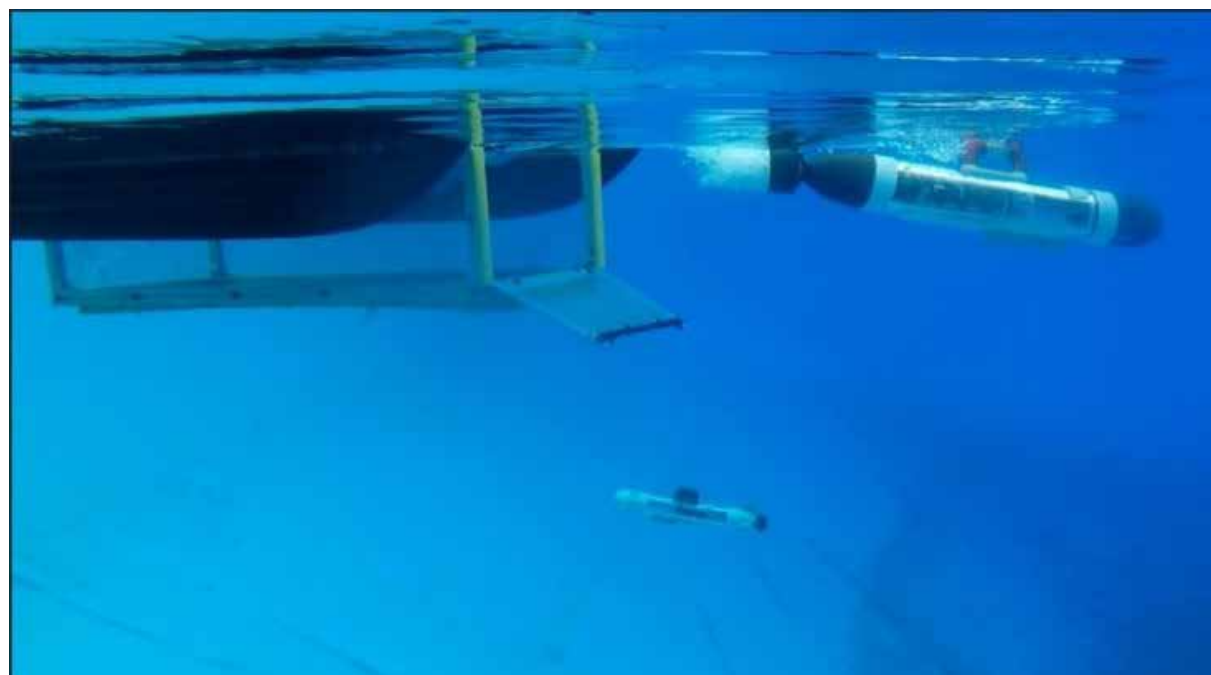


Figure 2. DREWUV post launch from Heron USV

WEAKLY-SUPERVISED SEMANTIC SEGMENTATION OF SYNTHETIC APERTURE SONAR IMAGERY

HIGHLIGHT:

X DEPARTMENT'S ADVANCED SIGNAL PROCESSING AND AUTOMATED TARGET RECOGNITION BRANCH, MADE SIGNIFICANT ADVANCES IN THE AUTOMATED ANALYSIS OF HIGH-RESOLUTION SONAR IMAGERY:

- ★ Developed a state-of-the-art deep-network framework for semantic image segmentation
- ★ Training data annotation requirements are extremely minimal
- ★ Reduction of manual annotation labor times by a factor of one thousand
- ★ Segmentation performance is like fully supervised methods and vastly exceeds existing weakly-supervised methods

The process of finding and labeling targets in sonar imagery enables intelligent systems to better understand and act in an underwater environment. This process can be challenging to automate due to the strong relationship between seabed characteristics and the level of difficulty in picking out targets on the seabed. Here, characteristics refer to seabed complexity, which is influenced by vegetation growth, wildlife activity, naturally deposited clutter, and ocean dynamics such as sand ripples.

In FY23, researchers at NSWC PCD leveraged knowledge of seafloor conditions to promote more accurate automated target recognition and analysis by developing a novel deep-network framework

to perform semantic image segmentation of sonar images. Semantic segmentation is a process that takes an image and returns a partition with regions labeled according to their contents. In the case of sonar image segmentation (see Figure 1), each pixel in the segmentation map denotes if a corresponding pixel in the sonar image belongs to either one of many seafloor classes or one of many target classes. These maps thus provide high-level, spatially dense descriptions of an underwater scene.

A defining trait of this framework is that it operates in a weakly-supervised manner as opposed to a fully supervised manner. The difference between the two approaches to segmentation is that a fully supervised method requires manual, ground truth full-image segmentations for training data, while our weakly-supervised method requires only the labels of seafloor types and target classes that appear in each image. That is, our method does not require any information about the spatial location of these classes. Instead, the network breaks the segmentation task into two parts, where the first part uses this sparsely labeled training data to infer fuzzy heat maps of where regions would most likely be, and the second part converts those fuzzy regions into sharp boundaries in a reasonable manner. The second part requires no training data, and at no point in the entire framework do we use human-derived, full-image segmentations for training as is the case for standard fully supervised methods.

Sidestepping the need for full-image training masks significantly reduces manual data annotation times. Typically, we observe thousand-fold reductions in annotation times compared to the case where we manually label each pixel for a set of training masks. This makes it quick and easy to incorporate new batches of data from underwater surveys and update the framework to account for potentially novel target classes and bottom types. Despite the limited supervisory signals in the training data, our work shows that this framework is highly competitive against fully-supervised-trained deep networks, and in some instances, the framework outperformed supervised-trained networks.

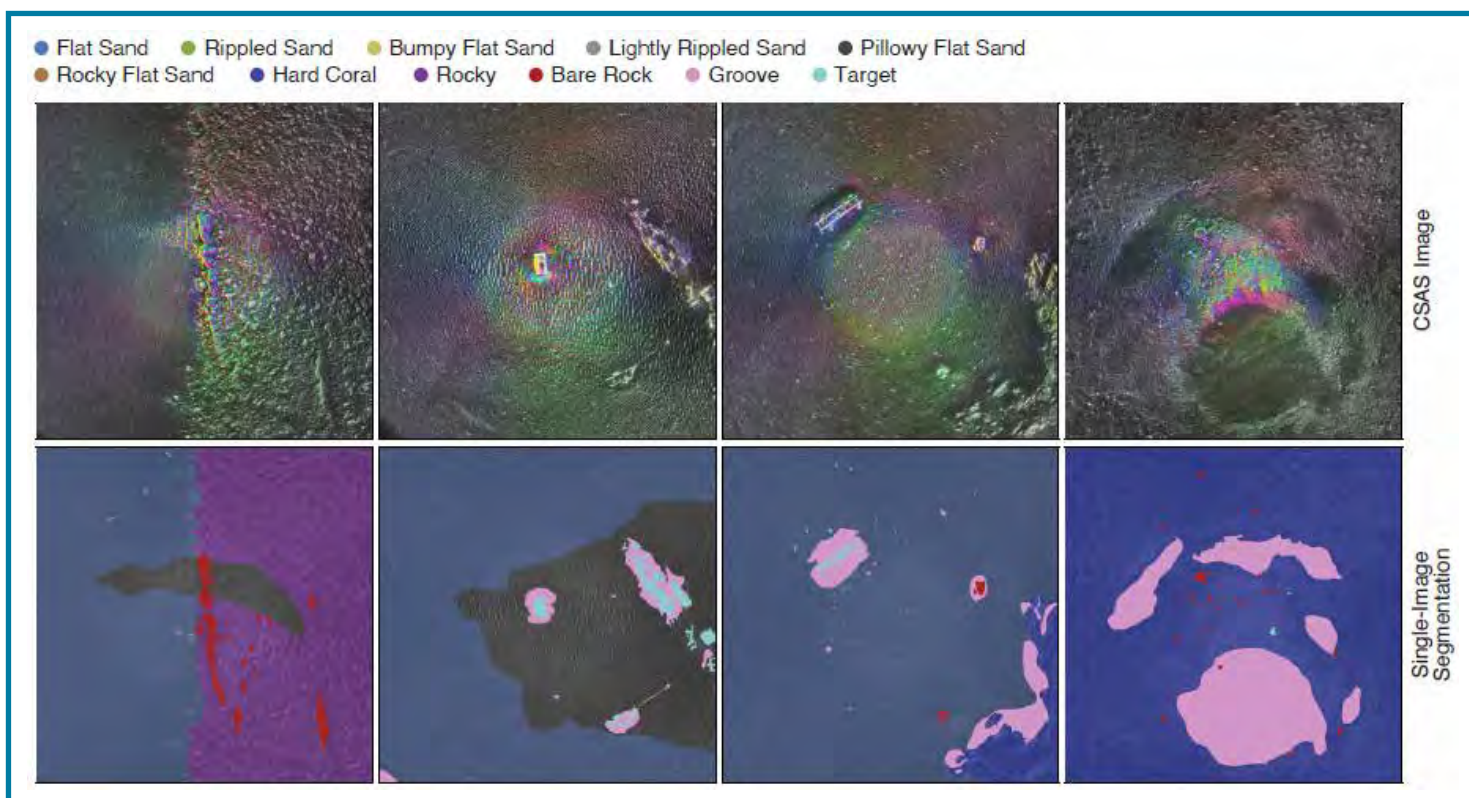


Figure 1. The framework yields high-quality semantic segmentation maps. These maps strongly obey class boundaries that are observed in circular-scan synthetic-aperture-sonar imagery.

While we tailored the framework to process circular-scan, synthetic-aperture-sonar imagery, one can apply it to other imaging modalities with few modifications. For example, it can segment and label forward-looking-sonar image feeds or even non-sonar-based modalities, such as a camera feed from an aerial drone. Since the framework is composed of lightweight deep networks, one can program the segmentation to execute in beyond-realtime rates, which helps with the formation of highly reactive highly reactive autonomous behaviors for such vehicles.

This framework provides a crucial component for developing next-generation minehunting systems that are completely autonomous and operate on par with, if not better than, sailors who are sonar operators. One of the biggest advantages of this framework is it sidesteps the need for traditional labor-intensive full image-based data annotation. Instead, scientists can produce high-performing models for scene analysis that rely on incredibly sparse amounts of supervisory signals. When fully implemented, we estimate significant

year-to-year savings given the amount of effort required at our warfare center to annotate imaging sonar data used in models for new environments and new tasks. On average, the reduction in time for producing a segmentation mask of a single circular-scan synthetic-aperture-sonar image by supplying labels of seafloor types and target classes is more than 300-fold compared to manual processing by a skilled individual. With many more data sets at other locations, and given the exponential growth of machine learning applications, this segmentation approach for synthetic aperture sonar imagery will be hugely beneficial.

CODE 01

Comptroller Department



Development of an enhanced Comptroller SharePoint site

- 1412 unique users and 32,000 site visits since going live in March 2023
- Consolidated Comptroller information into a new user-friendly site
- Subpages for each division within Comptroller
- Travel site is the most visited page in Comptroller

Tableau Data Analytics

- Developed executive leadership financial dashboard
 - Replaced manual monthly reporting with automated dashboard
- Developed funds management dashboard
 - Dashboard allows monitoring of funds acceptance to process funding more efficiently
- Developed End-of-Year missing time dashboard
 - Dashboard streamlined the end-of-year daily timesheet process for employees with missing time
- Developed user groups, in collaboration with Metrics, Analysis & Data calls Branch (Code 1063), on Tableau server
 - User groups provide control over security, integration, and customization of Tableau visualizations

Development and implementation of Funding Allocated to Locally Controlled Networks (FALCN)

- To improve efficiencies and transparency in the Financial Management of Funding Documents FALCN was created as a Funds Management software application

collaboratively with Comptroller, Technical Financial Managers, and Enterprise Services (Code 1044).

- Allows for instant visibility of funding document status by customers and streamlines the NSWC PCD Funds Management Office (FMO) processes.
- FALCN decreased our processing time by 16% for our annual average of 2,300 funding documents.

Annual Metrics

- Processed 2,264 Incoming Funding Documents and 840 Outgoing Funding Documents
- Final billed 1,032 sales orders, returning more than \$4M and successfully cleaned up 100% of FY23 lapsing sales orders
- Payroll processed and reimbursed 188 OF1164s, resulting in total payments made of more than \$60K.
- Total Travel dollars spent more than \$11M on 6,364 trips.
- Dormant records cleared: 7,563 (unliquidated obligations)



COMPTROLLER METRICS

FUNDING DOCUMENTS
PROCESSED:



←
2,264
INCOMING
840
OUTGOING
→

PAYROLL PROCESSED
& REIMBURSED

188  OF 1164S

RESULTING IN TOTAL
PAYMENTS MADE OF

**MORE THAN
\$60K**

DORMANT
RECORDS CLEARED:

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(UNLIQUIDATED
OBLIGATIONS)

**FINAL
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1,032
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RETURNING
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SUCCESSFULLY
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OF FY23 LAPSING
SALES ORDERS

TOTAL TRAVEL \$\$ SPENT
OVER \$11M

ON **6,364** TRIPS

CODE 02

Contracts Department

- Code 02 obligated \$250M in contract actions, an 18% increase from FY21, while experiencing 19% attrition.
- Awarded the Standoff, Target, Reacquire, Identify, Detection, Expeditionary Navigations Tool (STRIDENT) for ArtemisPro Units to Cardinal Point Captains, Inc. (CPC), a Service-Disabled Veteran-Owned Small Business (SDVOSB) for \$41M over a six-year period of performance, saving the government over \$6M from CPC's initial proposal. This contract will support a variety of missions for the U.S. Navy Explosive Ordnance Disposal (EOD) and Mobile Diving and Salvage (MDS) forces. This device will be used to search, detect, locate, reacquire, and identify mines, other underwater explosive threats, and other objects of interest during EOD and MDS operations to include, but not limited to Mine Countermeasures,

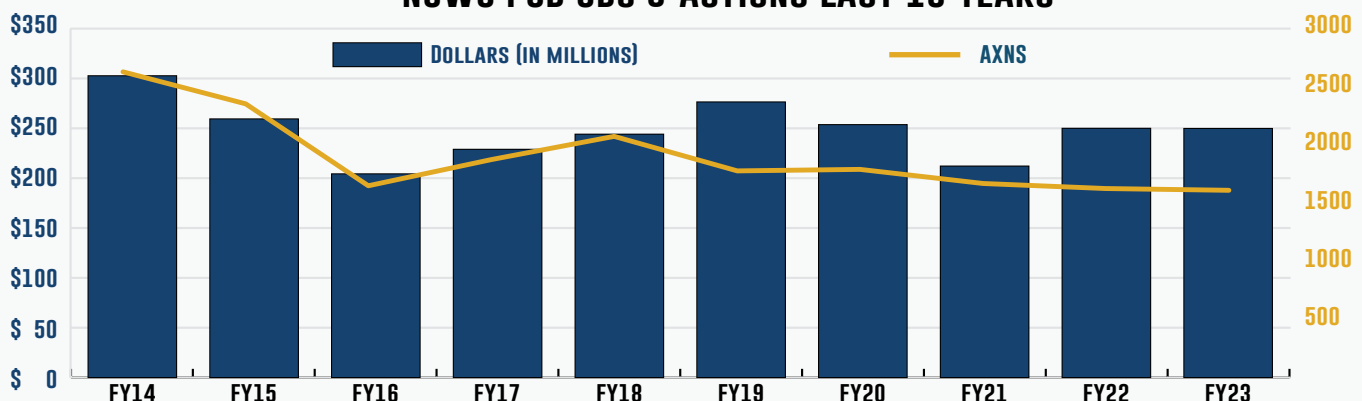
Underwater Search and Expeditionary Salvage diving operations.

- Awarded NSWC PCD's first Training Indefinite Delivery Indefinite Quantity (IDIQ) Contract on Feb. 7, 2023, to Kinetic Concept, LLC (an 8(a) contractor), for \$4.5M for a base of 12 months and one option year. This contract consolidates the Command's training buys allowing for better planning and more expeditious award of training requirements, vice sending each requirement to the NSWC PCD Small Purchase Office. Since its award, the team has awarded five task orders for 61 classes for a total of \$941K in obligations.
- Awarded the Command's first conference room contracts allowing easier procurement of off-base conference room space for large gatherings, since the base has limited space for such gatherings.

FY23 DIVISION OBLIGATIONS

DIVISION	ACTIONS (AXNS)	OBLIGATIONS	#1102s	\$/1102	AXNS/1102
22	340	\$ 89,732,695	13	\$ 6,902,515	26.15
23	608	\$ 136,508,587	18	\$ 7,583,810	33.78
24	539	\$ 19,223,056	7	\$ 2,746,151	77
25	51	\$ 2,187,770	2	\$ 1,093,885	25.5
28	3	\$ 2,211,628	1	\$ 2,211,628	3

NSWC PCD OBS & ACTIONS LAST 10 YEARS



CODE 10

Corporate Operations Department



EQUAL EMPLOYMENT OPPORTUNITY, DIVERSITY, AND INCLUSION (ED&I)

HIGHLIGHT:

CONTINUOUS ESTABLISHMENT OF EQUAL EMPLOYMENT OPPORTUNITY (EEO) PROGRAMS TO IMPROVE EQUAL EMPLOYMENT OPPORTUNITIES, TO INCREASE AWARENESS OF POLICIES, PROCESSES, AND HUMAN CLIMATE AT NSWC PCD.

The Equal Employment Opportunity Commission Management Directive 715 requires agencies to take proactive steps to ensure equal employment opportunity for all their employees and applicants by regularly evaluating employment practices on six essential elements, which the ED&I Office continuously works to attain these essential elements:

- Demonstrate commitment from agency leadership
- Integration of EEO into the agency's strategic mission
- Management and program accountability
- Proactive prevention of unlawful discrimination
- Efficiency
- Responsiveness and legal compliance

Impact:

- Exceeded all Federal workforce goals for Individuals with Disabilities and Individuals with Targeted Disabilities
- Teamed with Corporate Communication in hosting and coordinating PCD Day May 2023
- Established Settlement Circles and Closure Conferences to improve processes and transparency (Get Real, Get Better)
- Facilitated change of supervisor performance rating to include ED&I principles in April 2023
- Substantial increase of workplace Alternative Dispute Resolution (ADR) requests from zero in FY22 to six requests in FY23 to improve working conditions at lowest level
- Increased EEO ADRs by 23% continued 100 percent success rate
- Continued achievement of timely FY23 EEO pre-complaint counseling
- Collaborations with Employee Resource Groups (ERG), Morale Welfare Recreation, Naval Support Activity Panama City, Human Resources Division, and Corporate Communication Division resulted in the following:
 - Hosted 13 Special Emphasis Program (SEP) events with 819 workforce employees attending
 - More than 910 employees attended 24 Monthly Special Emphasis Program Meetings
 - Offered eight Joint Warfare Enterprise Center SEP Events
 - Hosted ERG events with 1,171 employees in attendance

HUMAN RESOURCES DIVISION (101)

HIGHLIGHT:

DEVELOPED DASHBOARDS- BUDGET, RECRUITING, HIRING METRIC SNAPSHOT, SIZE ANALYSIS, RETENTION ANALYSIS REPORT IN COLLABORATION WITH STRATEGIC PLANNING AND CORPORATE BUSINESS OFFICE.

The NSW PCD Planning, Policy, and Analysis branch collaborated with the Corporate Business Office Division's Metrics, Analysis & Data Calls Branch, and Strategic Planning to develop relevant solutions for data reporting and metrics. The Enterprise Data Warehouse dashboards consist of curated views relevant to senior leadership decision making, Human Capital health at various levels of the organization, and the monitoring of financial stewardship and execution.

Through the development of Human Capital and Financial dashboards, the Human Resources Division has increased work efficiencies through automated solutions and data output. The dashboards have enabled senior

leadership to receive timely metrics relevant to Human Capital and Financial Stewardship. The implementation of dashboards was a process improvement in the thrust area of Contextual Communication by removing manual scrubbing exercises with data. This process has also resulted in a Seamless Solution within the NSW PCD Corporate Operations department by leveraging our sister business offices in the development of a product that improves customer service.

INFRASTRUCTURE DIVISION (102)

NSW PCD hosted a groundbreaking ceremony in April 2023 for the Littoral Innovation and Prototyping Facility (LIPF). The LIPF will remedy a current lapse in collaborative and equipment capabilities present during research, development, test & evaluation (RDT&E) for Mine Warfare and Expeditionary Warfare operations conducted in the littoral battlespace. The 55,000 square-foot facility will support approximately 140 scientists and engineers in developing and testing the newest cutting-edge technologies for the U.S. Navy.

HIGHLIGHT:

**THE ENTIRE TEAM
COLLABORATED AND
SUPPORTED EACH OTHER
FROM REQUIREMENTS
PLANNING, DESIGN,
DEVELOPING SCOPES
OF WORK, AWARDING
THE CONTRACTS,
REVIEWING SUBMITTALS,
TO OVERSEEING
AND MONITORING
CONSTRUCTION, AND
CLOSING THE PROJECT OUT.**





Hydrospace Lab Showcase

CORPORATE COMMUNICATION DIVISION (103) HIGHLIGHT:

DEVELOPED THE LAB SHOWCASE SERIES IN JANUARY 2023. AS A MONTHLY OCCURRENCE, THE SHOWCASE FEATURES TECHNICAL CAPABILITIES AND FACILITIES AROUND THE BASE ENABLING NSWPCD'S MISSION READINESS.

The Lab Showcase introduces a new technology focus area each month intended to familiarize the workforce with the importance of the command's efforts and why it matters.

In 2023, NSWPCD held eight showcase events with approximately 1,200 personnel in attendance. This hands-on education enables the workforce to touch the missions they support, no matter where they sit within the organization. These events were also highlighted on the Command's social media platforms to engage the local community, connect with NSWPCD alumni and highlight the relevant work being done at NSWPCD. In FY23 versus FY22, social media traffic increased by 86 percent (37,190 visits) and page followers grew by nine percent (471 new likes) due to initiatives like these.

INFORMATION TECHNOLOGY DIVISION (104) HIGHLIGHT:

RED TEAM COOPERATIVE VISIT

NSWPCD went through a successful collaborative Red Team Inspection April 17-28.

The NSWPCD Information Technology Team proved their capabilities by identifying and stopping the Navy Red Team activities during this year's exercise where they were given full access and credentials into the Command's network to simulate a true insider threat scenario. Through the expert use of the Cyber Suite, including tools, such as Microsoft Defender Endpoint, Splunk cybersecurity capabilities, and Host Based Security System and locally developed Standard Operating Procedures, the NSWPCD incident response team reacted quickly and efficiently, successfully stopping the Navy Red Team's cyber threats on two separate occasions within one week. According to the Navy Red Team, amongst the warfare centers recently inspected, NSWPCD ranked at the top, as far as compliance and difficulty in demonstrating their ability to do anything they were not explicitly granted the permission to do.



SECURITY MANAGEMENT DIVISION (105)

COMSEC provides the security and protected communication infrastructure necessary to carry out national security work. Communication security is the bedrock all Navy and NSWC PCD missions depend on to meet their customer's needs, locally and across the globe.

The NSWC PCD Special Programs branch oversees 17 local elements and manages over 800 inventory Cryptographically Controlled information items. This capability provides the command access to critical resources such as Navy Marine Corp Intranet (NMCI), Secret Internet Protocol Router (SIPR), Joint Worldwide Intelligence Communications System (JWICS), and RDT&E, and supports customer programs, such as Unmanned Service Vessel (USV), Landing Craft Air Cushion (LCAC), Seal Delivery Vehicle (SDV), Maritime Security Program (MSP), and more. COMSEC provides researchers secure access to information they need.

HIGHLIGHT:

SECURITY OVERSEES THE MANAGEMENT AND EXECUTION OF THE COMMAND'S COMMUNICATION SECURITY (COMSEC) PROGRAM. COMSEC IS THE CRITICAL FOUNDATION SUPPORTING ALL RESEARCH AND DEVELOPMENT, TECHNICAL CAPABILITIES, TESTING, AND OPERATIONAL MISSIONS ACROSS THE INSTALLATION AND IS KEY TO THE COMMAND'S MISSION READINESS.

CORPORATE BUSINESS OFFICE DIVISION (106)

The ERP Extended Business Office offered several training sessions throughout FY23 geared towards providing guidance with various ERP transactions, helpful tips, and reports for beginner ERP users to advanced levels. The detailed training in areas of Operating Materials and Supplies, procurement, purchase requisition approvals, project structures, and timecard management was offered in classroom. In addition, Microsoft Teams sessions were offered during the NSWC PCD Quarterly Supervisory Foundations and the Employee Foundations trainings. These sessions focused on the upcoming changes within ERP relating to the conversion from Employee Self-Service and Manager Self-Service tools to a new web/HTML path for timecards and purchase requisition approval for supervisors.

Information provided to ERP users is vital to ensuring the required established business rules are being followed. Improvement in time-saved for correcting errors and improvement in data integrity for accurate project reporting. Reduction in the escalation of ERP national help desk tickets submitted for issues resulting in improved relations with the NAVSEA ERP Business Office. More than 175 NSWC PCD employees were reached, and users know they can contact the local ERP office for questions, issues, and where to find desk guides posted on the ERP SharePoint site.

HIGHLIGHT:

PROVIDED TARGETED ENTERPRISE RESOURCE PLANNING (ERP) SYSTEM TRAINING TO USERS IN AREAS OF OPERATING MATERIALS AND SUPPLIES FOR PROGRAM MANAGERS (PM), PROJECT PLANNING AND MONITORING AND PROCUREMENT FOR PMS, AND TIMECARD MANAGEMENT AND PURCHASE REQUEST APPROVALS FOR SUPERVISORS.



PROPERTY MANAGEMENT DIVISION (107)

The Property Management Division established three real-time feedback initiatives. The “Familiarization (FAM) Tour,” to which monthly on-site project overviews were coordinated affording face-to-face discussions between project and Property Management personnel to exchange ideas and share roadblocks; Kudos and Employee improvements for Your satisfaction (KEY), a customer survey affording direct-line feedback focusing on purchasing/asset management/supply operations and customer performance; and Communication Accountability Satisfaction and Employee Improvement, a customer survey centering on warehousing operations.

The Purchasing Branch rolled out the Grainger 4PL (Fourth Party Logistics) Program Command-wide, while simultaneously implementing the Customer Acquisition Group which creates all Grainger 4PL Requirement Forms (RF) orders effectively returning over 25 percent of engineer’s and scientist’s time. Purchasing processed over 9,400 purchase requests, a 30 percent increase in production from FY22, valued at over 400 million dollars, while reducing their overall RF processing times from 2.23 days in FY22 to 2.21 days in FY23.

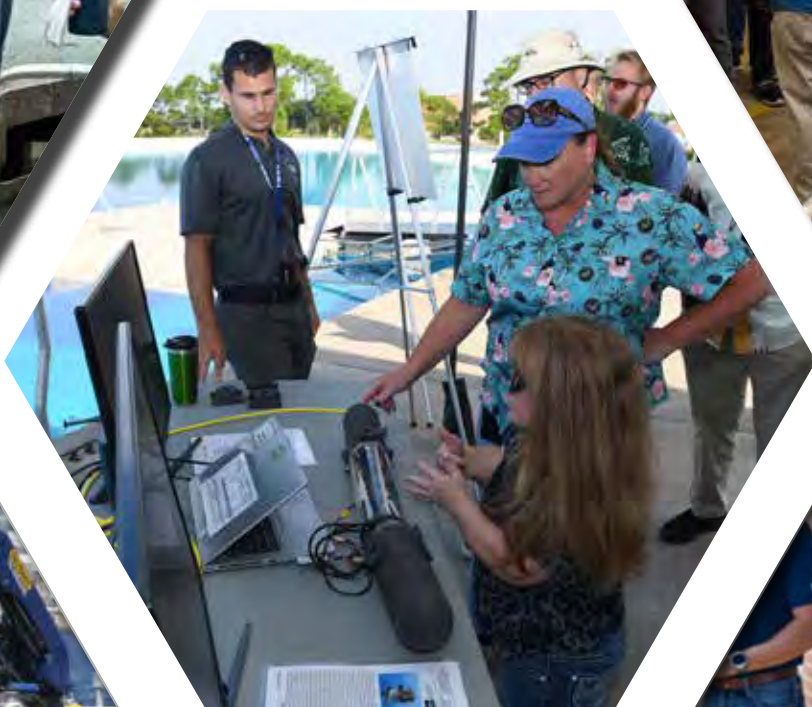
The Supply Operations Branch provided the fleet with over 750 line-item requisitions consisting of Depot Level Repair and Performance Base Logistics – Organic materials totaling five million dollars with an average turnaround time of two days. The branch manages and maintains over 11,000 line-items worth over 345 million dollars in addition to conducting over 2,300 line-item spot checks resulting in a 99 percent inventory accuracy rate for FY23.

The General Equipment Branch manages and maintains over 6,500 assets totaling 240 million dollars with a total inventory accuracy of 99 percent for FY23.

HIGHLIGHT:
**THE PROPERTY
MANAGEMENT
DIVISION
INSTITUTED
MULTIPLE
INITIATIVES AND
REVITALIZED
CURRENT
PROCESSES
TO FURTHER
STRENGTHEN
AND ENHANCE
THE CUSTOMER-
PROVIDER
RELATIONSHIP
FOR THOSE WHO
SUPPORT FOR THE
WARFIGHTER.**

OUR PEOPLE





2023
ANNUAL
Awards
NSWC PANAMA CITY DIVISION



Individual Awards



Lori Hilgenberg

BUSINESS EXCELLENCE



William Coffman

CAREER ACHIEVEMENT



Thomas Fanning

DR. DAVID P. SKINNER OUTSTANDING
SCIENCE & ENGINEERING



Donald Wittkopf

EXEMPLARY LEADERSHIP



Dave Tubridy

HALL OF FAME AWARD



Dr. Ivan Rodriguez-Pinto

NEW EMPLOYEE
EXCEPTIONAL ACHIEVEMENT



Joe Renella

OUTSTANDING
ORGANIZATIONAL SUPPORT



Charles Dillingham

TECHNICAL EXCELLENCE

Team Awards

COLLABORATION EXCELLENCE

SHIP-TO-SHORE CONNECTOR (SSC) SHIP INTERFACE TEST TEAM



From left to right:
Clyde Brown, Haydlee Slutzky,
Fiamma Fernandez, Aaron Nicholas,
Jena Rhea, Carlos Gonzalez-Montanez,
Jeffrey Kiser, Ronel Murillo-Pagan,
and Allen Martin

Not Pictured:
Dr. Robert Cole, Micheal Macdonald,
Timothy Nehring, and Kathleen Paul

EXCELLENCE IN BUSINESS INNOVATION

FUNDING ALLOCATED TO LOCALLY CONTROLLED NETWORKS (FALCN) TEAM



From left to right:
Kate Pennington, Cathy Haynes,
Emily Little, Joel Sasiela,
Connie Anderson, Amanda Davis,
Elizabeth Delay, Jamie Frederick,
and Charles Faircloth

Not Pictured:
Cory Bruckschen and Colleen McCoy

EXCEPTIONAL TECHNICAL EXCELLENCE

COASTAL TEST RANGE TEAM



From left to right:
Anthony Zarrilli, Paul Wray,
Casey Brennan, Andrew Head,
and Anthony Bush

OUTSTANDING FLEET SUPPORT

IN-SERVICE MINES PROJECT TEAM



From left to right:
Abigail Stutz, Maryanne Dertilis, Sean Smith, Mackenzie Brogdon, Loubens Octave, Sharon Brakey, Robert Bethea, Vincent Larsen, Michael Denny, Niklas Bacon, Eric Fernandez, Donald Kiper, Omar Hernandez, Kurobuboka Tamunoitekena, Quyen Le, and Thu-Thao Nguyen

Not pictured: Christopher Auvil, MNCS Luis Flores, Donald Hobden, Zachary Luther, Cameron Prosser, David Robinson, Joshua Roddenberry, Johnnie Steele, and Maria Weilbacher

OUTSTANDING INNOVATION

AIR CUSHION VEHICLE (ACV) MODEL-BASED PRODUCTION DEVELOPMENT (MBPD) TEAM



From left to right:
Quinn Straub, SGT Alexander Morgan, Kendra Wardlow, Kevin Meaux, and Ira Haraughty

Not pictured:
Brian Delmar, Micheal Macdonald, and Ashley Rauch

OUTSTANDING PROGRAM SUCCESS

ADAPTIVE PERSISTENT AWARENESS SYSTEMS (APAS) COUNTER-UNMANNED AIRCRAFT SYSTEMS (C-UAS) TEAM



From left to right:
Dominic Nguyen, Dr. Jacqueline Jermyn, Jeremy Johnson, Roscelin Figueroa, Daniel Klemfuss, and Jeffrey Kiser

Not pictured:
Jonathan Faranda, Tyler Hoover, Kevin Larimore, and Marvin Peardon

OUTSTANDING TEAM ACHIEVEMENT

HAWKEYE EXPEDITIONARY LAUNCH MODULE (HELM) TEAM



From left to right:
Dr. Andrew Schicho, Niraj Thakkar,
Corey Lounsbury, Michael Tavarone,
Richard Kim, Braylee Brown,
Mackenzie Blair, Robert Herman,
Miguel Angelo Salinas, Randolph
Hetzl, Emily Kiehn, Walt Hollis,
Haydlee Slutzky, Amanda Small,
and April Hirsch

Not pictured:
Frank Allen, Chloe Cribbs,
Jeremy Croom, Blake Delahoussaye,
Joseph Earnest, Brian Eckert,
Wesley Gerow, James Goodwin,
Benjamin Nelson, Timothy Pride,
and Kelly Williams

Patents

BIODEGRADABLE MICROPHONE

April Hirsch

Not pictured: Dr. Josh Kogot



RELEASE SYSTEM FOR A TETHER LINE

**Robert Herman*

*Not pictured: Demetrius Kutzke
and Gustavo Miranda Lopez**



Not pictured:

METHOD OF COLLECTING FIELD-BASED DATA TO REDUCE COLLECTED DATA ERROR

Michael Kobald



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