



UNITED STATES COAST GUARD

Research & Development Center

Annual Report 2016

www.uscg.mil/acquisition/rdc/rdc.asp





Rear Admiral Joseph Vojvodich speaks with employees at the RDC during the Annual Assessment of the Prospective Portfolio April 12-13, 2016.

“The Research and Development Center and RDT&E Program are leaders in addressing the critical challenges facing the Coast Guard in the field. They utilize a wide range of strategic and operational partners to stay ahead of the curve in a rapidly changing environment and are forward-thinking change agents. The future of the Coast Guard begins with R&D.”

-- RADM Joseph Vojvodich, Assistant Commandant for Acquisition and Chief Acquisition Officer

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FRONT COVER Top: LT Keely Higbie demonstrates the launching mechanism for the Puma sUAS while at the Research and Development Center, District 1 and the Department of Homeland Security's Joint Base in Cape Cod.

Bottom: The RDC conducted an Operational Test and Evaluation (OT&E) of the less-than-lethal impact munition PepperBall Launcher System as a Step III (Disrupt) non-compliant vessel (NCV) use of force tactic. The OT&E began on June 1, 2015, and ended May 31, 2016.

BACK COVER Top: ENS Hessamodkkin Shafeian of the RDC and Amy Kukulya of Woods Hole Oceanographic Institution recover the REMUS-100 Autonomous Underwater Vehicle, which can be used to detect oil in the water.

Bottom: LT Joseph DiRenzo joins a team of First Responders in New York City while working with the DHS National Urban Security Technology Laboratory to promote and discuss advances in science and technology applications.

Mission

Provide innovative technologies, premier analysis, and decision support to enhance operational performance and reduce acquisition risk across all U.S. Coast Guard missions.



The Coast Guard Research and Development Center (RDC) cooperated with the Naval Research Laboratory (NRL), Bureau of Safety and Environmental Enforcement (BSEE), and Department of Energy's (DOE's) Pacific Northwest National Laboratory (PNNL) to conduct a series of Controlled Test Burns of Crude Oil at the Joint Maritime Test Facility (JMTF) in Mobile, Alabama. BSEE and PNNL are currently working to develop an aggregator that would improve the burn efficiency of crude oil during an oil spill response. They requested use of RDC's burn pan located on Little Sand Island in Mobile Bay to carry out a series of small burns over the course of a week. The series of test burns was successfully completed and provided the RDC with an opportunity to build on its experience as a test facility host for in-situ burn research. With the hydraulic wave generator coming on line soon, the JMTF will become a leading outdoor facility for collaborative in-situ burn research.

Commanding Officer of the Coast Guard RDC

CAPT Dennis C. Evans

2016 has been an incredible year for the Research and Development Center (RDC), marked by the delivery of numerous high-return, high-impact and high-visibility products that resonate on the national level.

We continued our build-out of the Coast Guard Maritime Operational Effectiveness Simulation, Version 3.0 (CGMOES 3.0). CGMOES 3.0 is an incredibly powerful tool, with the capability to model Coast Guard operations over large geographic regions over the course of an entire year. CGMOES can model all homeport and scheduling details of all Coast Guard deepwater assets (all Fast Response Cutter and larger, all aviation assets, actual or envisioned). Using CGMOES, we were able to complete a series of Fleet Mix Analyses to model the operational effectiveness of future Coast Guard fleets, which validated the critical need for the Offshore Patrol Cutter (OPC) class, among other study questions. These analyses were key elements in supporting the DHS Secretary's August 2016 decision to move forward to the detail design and construction phase of the OPC, a contract award with a potential value reaching up to \$2.38B for the construction of up to nine hulls. This is the first stage of the replacement project for the Medium Endurance Cutter fleet, which could potentially be the largest acquisition project in Coast Guard history.

Our high-profile successes don't end there. We reconstituted our burn pan capability at our Joint Maritime Test Facility (JMTF) in Mobile, Alabama. This is the only federal facility permitted for open air oil burns, allowing us to research methods, impacts and concerns associated with in-situ oil burning. Controlled oil burns were a key component of the Deepwater Horizon response, and are one of the most effective methods for removing large-scale spilled oil from the environment. The RDC was also proud to be called to support the Marine Board of Investigation (MBI) query into the sinking of the SS El Faro. Our testing was conducted to study immersion suit endurance after issues arose during the search for El Faro's crew members. Our test showed that tethered but free-floating mannequins, clad in the same type of immersion suits El Faro carried, remained afloat for extended periods. In yet another example of RDC engagement, both Republican and Democratic National Conventions were held at arenas on or near the waterfront. The RDC was able to apply Automatic Identification System (AIS) technology in an innovative manner to directly broadcast security zone details onto the chart plotters onboard area vessels. In another initiative, the RDC partnered with the DHS Science & Technology (S&T) Directorate in conducting a prize competition to crowd-source innovative designs for an environmentally friendly buoy mooring system.



As the DHS Under Secretary for Science and Technology said, "Reaching out to citizen scientists for their creative ideas is important to our ability to improve safety and security across the nation." I could easily continue on for pages in touting RDC's incredible accomplishments in 2016. Instead, I'll cordially invite you to explore our Annual Report in the pages that follow.

There are two overarching themes to the RDC's many high-impact successes in 2016. The first theme is people. Particularly in challenging budget environments such as we now face, we more and more find ourselves looking inward to execute the Coast Guard's Research and Development programs. While we do of course contract some research, the overwhelming majority of our work is completed in-house by our dedicated team of 86 RDC employees. We have an extremely committed and capable group of researchers and scientists with an incredible depth and breadth of subject matter expertise. RDC's accomplishments are the accomplishments of our people. The second theme is partnership. We do not work in a vacuum, and look to leverage the outstanding work of many other organizations throughout government and industry. Frequent partners include DHS Science and Technology (S&T); Department of Defense (DoD) organizations; Federally Funded Research and Development Centers (FFRDCs); federal laboratories, universities, and industry through Cooperative Research and Development Agreements (CRADAs); the public at large; and many, many others. By building upon the work of our partners and focusing on potential application to Coast Guard missions, we are able to maximize the return on investment we bring back to our service.

People. Partnership. This is how we work. This is who we are.

RDT&E Program Manager

Wendy Chaves

Leading the RDT&E Program provides a tremendous opportunity to work directly with our customers, stakeholders, and field personnel to identify the service's most pressing gaps and challenges, to ensure our research and development efforts are addressing the highest priority needs of our operators and decision-makers, and are aligned with Coast Guard strategic imperatives. Many of the projects that the RDT&E Program has embarked on have come from people like you, who have identified technology improvements that could potentially improve Coast Guard operations, reduce risk, or enable decision making. In December 2016, we held our Idea Submission Review (ISR) where Coast Guard stakeholders reviewed and voted on 97 ideas for consideration in the FY18/19 RDT&E Project Portfolio. From there, the ideas go through a strategic executive-level prioritization process, with a final approved portfolio in August of each year. The Domain Leads in CG-926 guide stakeholders and keep them informed throughout this process. On behalf of the RDT&E team, I would like to take this opportunity to thank our idea submitters, sponsors, and stakeholders for the support that you provide to the portfolio development and execution process; your participation is critical to the success of the program and our ability to address the service's highest-priority needs.

One exciting change for the RDT&E Program this year has been the incorporation of the Coast Guard Innovation Program. We are diligently working to increase unity of effort and collaboration between RDT&E and Innovation so these programs can work in tandem to solve unique challenges across the Coast Guard, at all levels. I would encourage each of you to join over 4,500 Coast Guard Civilian, Active Duty, Reserve, and Auxiliarists on CG_Ideas@Work, our crowdsourcing platform, to give us your feedback on various challenges facing fellow Coast Guard personnel. This site can be found at <https://cg-ideasatwork.ideascale.com/>.

Moving forward, I cannot emphasize enough the importance of our growing strategic partnerships, to include DHS S&T, academia, industry, national labs, and other federal agencies and services. Our relationship with DHS S&T's Homeland Security Advanced Research Projects Agency (HSARPA), Research & Development Partnerships (RDP), Capability Development Support Group (CDSG), and Homeland Security Enterprise and First Responders (FRG) continue to strengthen. In fact, this year we added a DHS S&T representative, Dr. Isaac Maya, to the onsite CG-926 team. With our modest Coast Guard RDT&E budget, we must leverage the innovative solutions that all of our federal and non-federal partners

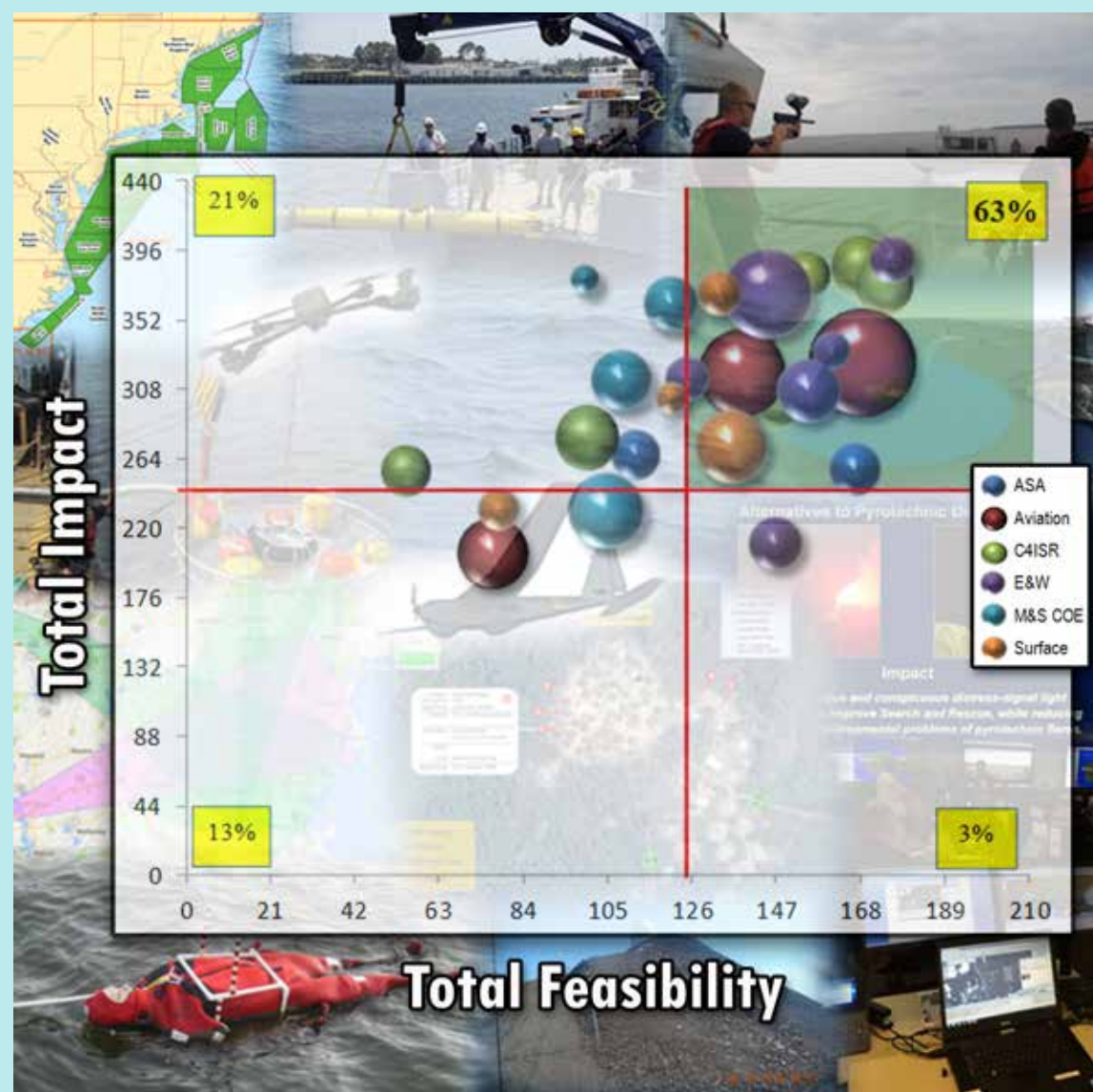


bring to the table if we are to solve the service's most complex challenges. Keeping pace with innovation and technological advancement requires engagement with the top subject matter experts from across the research and development community. This will continue to be a strategic focus area moving forward.

As you read through the annual report, I hope it spurs some thoughts on your own unique challenges or innovative solutions. We would love to hear them. We collect ideas year round whether it be through CG_Ideas@Work or our RDT&E Idea Submission site at <https://cg.portal.uscg.mil/units/cg9/2/6/rdc/SitePages/IdeaRequest.aspx>. Together we can solve these challenges and ensure the Coast Guard is fully prepared to support the priorities of the nation.



Overview: “RDC Delivers Big Punch”



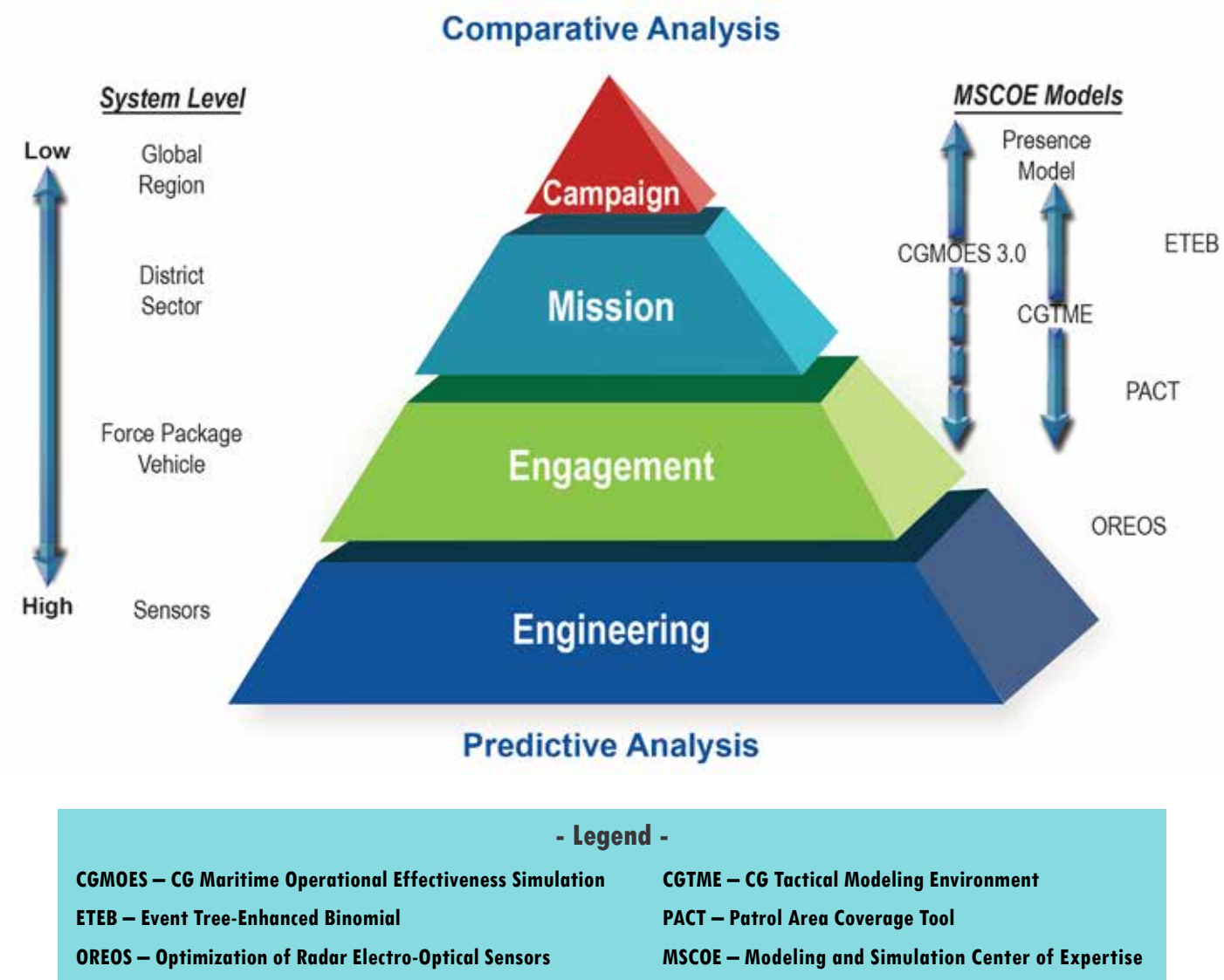
Projects are chosen based on a comprehensive assessment framework juried by senior leadership and depicted above in their overall impact and feasibility ratings. The RDC applies best industry practices to develop, evaluate, and execute a balanced Coast Guard R&D Portfolio.

“...The Coast Guard R&D program has been a significant force multiplier for the strategic, operational, and tactical levels of the service. From developing more effective ways to conduct operations to looking for new systems to address growing issues within the Maritime Transportation System, the Coast Guard RDC has been an agile capability within the service. At any given time, the program is working on more than 70 projects that support Coast Guard requirements across all mission areas, pursuing technologies that provide incremental improvements as well as those with the greatest potential to strategically transform the way the Coast Guard does business.”

Excerpts from the August 2016 issue of Proceedings; Copyright © 2016 U.S. Naval Institute / www.usni.org

To see the full article follow the link: <http://www.usni.org/magazines/proceedings/2016-08/rd-center-delivers-big-punch>

Modeling & Simulation Center



Modeling and Simulation (M&S) is becoming an integral part of the way the Coast Guard conducts business. From research, development, acquisition, and sustainment, to training and operations, use of Modeling and Simulation extends throughout the Coast Guard. Increased technical capability, competing mission demands, and a modest Coast Guard budget drive its expanded use.

The RDT&E Program’s Modeling and Simulation Center of Expertise (MSCOE) was established at the RDC to serve as a nexus for Coast Guard operational modeling. The center is staffed by experts with a combined modeling experience of over 35 years. Their efforts concentrate on maritime operation effectiveness tackling the most complex analytical challenges impacting the Coast Guard. The MSCOE provides decision makers with responsive, low-cost, low-risk modeling for effective strategy and mission support.

Last year, the MSCOE continued development of a key tool called Coast Guard Maritime Operational Effectiveness Simulation (CGMOES) 3.0. CGMOES has been identified as the primary modeling tool to support the Coast Guard in fleet acquisition programs. Working with Coast Guard Headquarters Sponsors in the Capability Directorate (CG-7), Area Planning Staffs, and the Department of Homeland Security (DHS) Program Analysis and Evaluation staff, the MSCOE completed a two-phased Fleet Mix Analysis designed to address a number of topics tied to the Coast Guard’s Capital Investment Plan, including support for the planned acquisition of the critical Offshore Patrol Cutter (OPC). The modeling analysis provided the analytic validation that OPCs were required to fill the long-range, high-persistence, organic aviation-capable cutter capacity that could not be met by the National Security Cutter (NSC) and Patrol Boat classes alone.

Unmanned Systems Operational Capability



ET1 Michael Torgesen operates the UMS during its first unmanned sortie.



Communication Tower to transmit the remote control commands.



Naval Undersea Warfare Center (NUWC) RHIB UMS platform.

RDC staff members were trained to operate the InstantEye sUAS in June 2016 as part of the Robotic Aircraft for Maritime Public Safety (RAMPS) project. The RAMPS goal is to refine the Tactics, Techniques, and Procedures and Concept of Operations for appropriate UAS tools which are scaled to operate from various corresponding Coast Guard platforms.



The RDC is working to support the Coast Guard's UAS needs and is actively investigating improvements in technology, platforms, and payloads to support Coast Guard operations.

The RDT&E Program's expected commitment to unmanned and autonomous platforms and sensor technologies over the next decade was part of the 2016 move to create the RDC Systems and Unmanned Technology Branch. This area of research will support the Coast Guard's future recapitalized fleets with the next technological incremental improvements. The RDC continues to evaluate unmanned maritime systems for persistent surveillance activities under the Assessment of Unmanned Maritime Vehicles for Coast Guard Missions (7808) project. The project includes evaluating various concepts of operations and launch and recovery tactics, techniques, and procedures from Coast Guard assets.

The RDC conducted four small unmanned aircraft system (sUAS) demonstrations in support of the Robotic Aircraft for Maritime Public Safety (7807) project to better understand the risks, benefits, and limitations of operating existing commercial-off-the-shelf sUAS in a maritime environment on assets that are not equipped with flight decks. The RDC partnered with the private sector and Fortune 500 companies utilizing Cooperative Research and Development Agreements (CRADAs). The team evaluated the various platforms and electro-optical (EO)/infrared (IR) capabilities by operating through a Coast Guard-specific mission obstacle course in the waters off St. Inigoes, Maryland. The project's next phase includes evaluation of payloads other than EO/IR for Group I/II sUAS that can support Coast Guard operations.

The RDC also secured the Coast Guard's first approved FAA Certificates of Authorization (COAs) for sUAS operations in

the National Airspace System (NAS). One COA is for Class G airspace between Woods Hole, Massachusetts, and Martha's Vineyard, Massachusetts, where the RDC is partnering with District 1 to assess the use of UAS for ice extent searches and aids to navigation surveying post-storm events. The other is Class D airspace at Joint Base Cape Cod for the demonstration of UAS platforms and payloads to support future DHS and Coast Guard evaluations. The RDC is also working on another Class G airspace over Cape Cod Bay which will add an additional 575 square nautical miles of maritime environment for UAS test and evaluation. Class D airspace is a controlled airspace, generally from the surface to 2,500 feet above the airport elevation surrounding airports that have an operational control tower. Class G is completely uncontrolled. Visual flight rule requirements in Class G airspace are 1 mile by day, and 3 miles by night, for altitudes below 10,000 feet mean sea level but above 1,200 feet above ground level.

Unmanned Maritime Systems (UMS) for Coast Guard Missions. The RDC conducted testing early in June 2016 in District 8 – South Padre Island, Texas. The demonstration utilized a Government-off-the-shelf Rigid Hull Inflatable Boat (RHIB) rigged to operate from a Command and Control (C2) station on shore. The team conducted the first unmanned night operations in the bay while continuing to train using the infrared system. This effort challenged conventional wisdom and created an organizational dialog about the future of unmanned systems and International Regulations for Preventing Collisions at Sea (COLREG) implications.

Coast Guard Science & Technology Innovation Center

The Coast Guard Science & Technology Innovation Center (CG-STIC) is a collaborative effort between DHS Science and Technology (S&T) and the RDC which is dedicated to leveraging innovation, prototyping, and rapid integration of high technology solutions to answer the operational challenges of the Coast Guard and DHS. It was conceived as a response to the DHS Secretary's "unity of effort" initiative.

"Over the years, we have had successful joint projects and a good working relationship with the Coast Guard [Research and Development Center]. The new [center] helps formalize this partnership and will push it to the next level where our two organizations work closely together toward a culture of innovation and shared knowledge in order to quickly transform science and technology into operational capabilities for the Coast Guard."

— Anh Duong, who at the time was director of Department of Homeland Security Borders and Maritime Security Division

The CG-STIC was officially opened in May 2016 and will continue to develop prototypes and modifications from existing commercial-off-the-shelf technology and host technology capability demonstrations to counter emerging and anticipated threats. The center will also focus on evaluating high Technology Readiness Level products that have a connection to Coast Guard and DHS statutory missions.

Coast Guard Deputy Commandant for Mission Support RADM Thomas Jones said that the Innovation Center "supports the strategic goal of offering technology alternatives through innovation," noting that it is "important to transition programs to our operators."



With the center officially open and operating, the Coast Guard is now better positioned to identify and leverage opportunities, such as Autonomous Maritime Radio Tracking (AMRT), and rapidly offer these solutions to the fleet. Coast Guard Deputy Commandant for Mission Support RADM Thomas Jones is shown examining an early version of the RDC AMRT prototype, the Maritime Object Tracking Technology.

Dr. Robert Griffin, Under Secretary (Acting) for DHS Science & Technology, underscored the necessity for an institute such as the CG-STIC. "The technology we can bring to the Arctic, the quicker we can get technology to the area, the stronger and safer it will be."

Partnerships

"Partnerships are the ultimate force multiplier when collaborating, listening, and partnering with industry, academia, and our international friends...."

— ADM Charles D. Michel, October 2015 San Diego's Blue Ocean Technology event

The ability to engage and partner with organizations such as DHS S&T Office of University Programs (OUP) and universities through their Centers of Excellence (COE), unaffiliated universities, and national labs has allowed the RDT&E Program to leverage capabilities and significant skill sets that enhance those of the RDC technical staff.

The RDC has been working on **Maritime Cyber Research** with leadership at the DHS COEs, including Rutgers and the University of Southern California, American Military University, the University of San Diego, the Office of Port & Facility Compliance (CG-FAC) and Coast Guard Cyber Command. The schools produce White Papers that explore multiple areas including vulnerabilities, resilience, threats, consequences and information-sharing protocols. The papers are provided to Coast Guard Headquarters for distribution to the Areas, Districts and Sector Area Maritime Security Committee (MSC) Cyber Subcommittees.

During 2016, the RDT&E Program partnered with two of the **National Labs** – Oak Ridge and Lawrence Livermore. The Oak Ridge collaboration included RDC Project Managers gaining an opportunity to immerse themselves in the current "state of the market" of adaptive manufacturing, exploring ammunition and new types of body armor. Oak Ridge, Naval Air Systems Command (NAVAIR), and the RDC joined efforts to implement a cyber malware capability dubbed "HYPERION." Other laboratory engagement opportunities will be explored during 2017.

Representatives from the RDT&E Program, the Coastal Resilience Center of Excellence (CRC) and academic and practitioners from around the country came together in 2016 for the Maritime Risk Symposium to explore the topic of "Integrating Maritime and Coastal Resilience." The RDC and Tiffin University will partner in 2017 to host the symposium, which will focus on cyber-security issues with the Maritime Transportation System.

The RDT&E Program pursued engagement with **DHS S&T National Urban Security Technology Laboratory (NUSTL) and Defense Innovation Unit Experimental (DIUx)**. Reciprocal staff embeddings between NUSTL and RDC have resulted in targeted ongoing collaborations including joint efforts in counter-UAS. The DIUx partnership has expanded to connecting technology entrepreneurs in areas such as Underwater Unmanned Vehicles (UUVs) and Small Unmanned Vehicles (SUVs).

As a result of follow-up to work under the Recovery of Heavy Oil Project, the Office of Marine Environmental Response Policy revised the **Oil Spill Response Organization (OSRO) Guidelines** to provide a new Non-Floating Oil classification in 2016. The project identified technologies that can detect and recover sunken oils and provided information for Federal On-Scene Coordinators (FOSC) and plan reviewers. The OSRO Guidelines require organizations to address non-floating oils within their plans and meet a minimum level of safety and capability.



Weighted mannequins were used for the Immersion Suit Floatation demonstration. The Aids to Navigation Team Mobile retrieved the test gear.

The RDC held its fourth **Oil-in-Ice Demonstration** in Narragansett Bay near Newport, Rhode Island, during August 2016. It was an on-water effort conducted to evaluate the responders' ability to integrate and operate multiple pieces of oil spill response equipment adapted for the cold weather while underway on U.S. Coast Guard Cutter Juniper. Specific equipment included an Ice Management System designed to protect a skimmer from ice damage and two temporary storage tanks that were erected on Juniper's deck to avoid punctures by ice. The demonstration produced many valuable lessons that are applicable to ice-infested waters within the continental United States and in the Arctic waters of Alaska.

After loss of life with the 2015 sinking of the SS El Faro, a USCG Marine Board of Investigation reviewed why recovery teams could not locate the remains of a victim in an immersion suit which had been spotted earlier by searchers. The RDC was asked to help analyze previous immersion suit experiments separate from the testing requirements in 46 CFR 160 and whether the El Faro's **Immersion Suits** could potentially remain afloat after extended time in the water.

The RDC provided results of a test to see if weighted mannequins using the same El Faro type of immersion suits showed any loss of floatation after a two-week period. This was posted as a supporting study to the December National Transportation Safety Board (NTSB) report.

The RDC participated in **Arctic Chinook**, a full-scale mass rescue field exercise. In August 2016, nearly 30 role players portrayed 200 injured passengers and crewmembers from the fictitious adventure cruise ship Arctic Chinook. They were transported from a simulated remote Arctic location outside of Kotzebue, Alaska, to higher care facilities in Kotzebue and Nome. The RDC's focus was to demonstrate the newly developed incident management tool called **Next Generation Incident Command System (NICS)**, as well as to test line of sight and beyond line of sight communications capabilities.



The Coast Guard Office of Navigation Systems and the RDC are working with the USACE Research and Development Center on the Ohio River and part of the Mississippi River to fully implement electronic Aids to Navigation (eAToN) and electronic Marine Safety Information (eMSI). The blue diamonds are eAToNs that assist the mariner in navigating around the lock. The yellow dots are eMSI, which provide the mariner critical pieces of information that enhance situational awareness.

Digital troposcatter technology was set up across a 100-mile range to extend a data network to the remote Arctic location. Direct connection was further extended directly to responders who were carrying Mobile Adhoc Network (MANET) radio technology with the NICS tool. The tool enabled situational awareness plus the control of personnel and assets working the response. The established network enabled the responders to pass live video from their body cameras directly to command centers in Juneau and Anchorage. The RDC tested and utilized the Distributed Tactical Communications System (DTCS), a newly developed Iridium push-to-talk radio system with global

coverage, during equipment setup and throughout the exercise.

The Automatic Identification System (AIS) exchanges maritime safety/security information between vessels and shore stations and provides a means for tracking vessel movement. However, AIS can also be a means to transmit other information to ships, such as meteorological data, carriage of dangerous cargos, safety and security zones, and the status of locks and Aids to Navigation.

The Coast Guard, in concert with the U.S. Army Corps of Engineers (USACE), has been conducting a 12-month technology demonstration in a test area on the Ohio River, to provide **electronic Marine Safety Information (eMSI)** – Electronic Aids to Navigation (eAToN) and AIS-Western Rivers Technology – to mariners in the test area. The key goal of the demonstration is to inform policy and authority requirement decision-making for providing information to support safe navigation based on testing of selected navigation and e-MSI information to mariners.

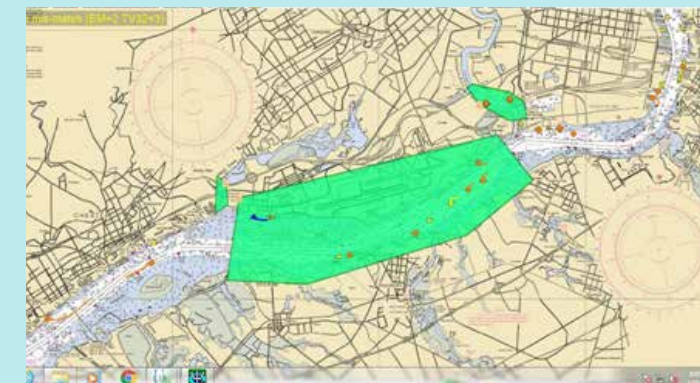


To support the Oil in Ice Demonstration, an Ice Cage is loaded onto the USCGC Juniper in Narragansett Bay.

The RDC cooperated with the Naval Research Laboratory (NRL), Bureau of Safety and Environmental Enforcement (BSEE), and the Department of Energy's (DOE's) Pacific Northwest National Laboratory (PNNL) to conduct a series of **Controlled Test Burns of Crude Oil at the Joint Maritime Test Facility (JMTF)** in Mobile, Alabama. BSEE and PNNL are currently working to develop an aggregator that would improve the burn efficiency of crude oil during an oil spill response. They requested use of the RDC's burn pan located on Little Sand Island in Mobile Bay to carry out a series of small burns over the course of the week. The series of test burns was successfully completed and provided the RDC with an opportunity to build on its experience as a test facility host for in-situ burning research. With the hydraulic wave generator coming on line soon, the facility will become the nation's go-to outdoor facility for collaborative in-situ burn research. Government agencies, industry, or academia interested in performing in-situ burning at the JMTF for their oil spill response research purposes are encouraged to contact the RDC.

RDC Products in the Field

In response to the Office of Navigation Safety's (CG-NAV's) request to **Broadcast AIS Notice to Mariner Security Zones During the National Conventions**, the RDC created a portable, deployable "digital lightship" go-kit enabling transmission of security zones via VHF Automatic Identification System (AIS) frequencies. The go-kit consisted of an AIS transmitter and a laptop computer with software to generate the AIS application messages and delivery. The transmissions were created to mirror the geographic descriptions provided in the Coast Guard Notice to Mariners. Sector Buffalo and Sector Delaware Bay Captains of the Port placed various restrictions on port access during the week-long events. Transmission of the active zones via AIS enabled mariners to see a depiction of the active zone on their navigational display systems.



AIS Exclusionary Zone for the Democratic National Convention.

The RDC's Non-Lethal Impact Munitions project conducted limited user evaluation in Districts 7, 8, and 11. In District 7, several Key West Fast Response Cutters have been trained and equipped to use PepperBall as a Non-Compliant Vessel Use of Force Higher Level Tactic (Step III) within the authority of the RDC's evaluation. The RDC is evaluating the PepperBall pepper spray projectile system as a non-lethal impact munition to disrupt and stop non-compliant vessels.



RADM Michael F. McAllister, Commander District 17, visits the PepperBall display and other exhibits on the third deck at the RDC.

D7 had the Coast Guard's first successful stop of a non-compliant vessel with PepperBall. CGC Kathleen Moore initially deployed the RDC product, the Net Vessel entangler, with negative results and then switched to the use of the PepperBall, which caused the vessel to become compliant. CGC Kathleen Moore then embarked the migrants that the non-compliant vessel was carrying onboard.

The **HOAX Location Systems** project seeks to compare and contrast possible technological solutions for combating Search and Rescue (SAR) hoax calls. The "three-prong" approach includes various Direction Finding (DF) methods, social media exploitation and correlation, and voice forensics analysis technologies for violator identification and case prosecution. The DF prong includes integrating multiple Lines of Bearing (LOB) from Rescue 21 sites and specially designed VHF "Go Kits," plus signal analysis of received VHF transmissions. The social media prong captures and geo-references nefarious social network posts for situational awareness, resource planning, and law enforcement evidence collection. The voice forensics prong includes Coast Guard Investigative Service (CGIS) agents working with Carnegie Mellon's Command, Control, and Interoperability Center for Advanced Data Analysis (CCICADA) program (academia) to analyze captured audio files for voice recognition characteristics.



The International Electrotechnical Commission (IEC) 61162 Interface, 62320 AIS Shore Station, and Shipboard (AIS) was released to support the advancement of next-generation, electronic Navigation (eNav) as well as maritime communications technology products and services.

RDC Visitors and Events



ADM Paul Zukunft expressed appreciation for the work done by the RDC to support Coast Guard missions during a visit to the center on March 1, 2016.

Area Commanders Visit the RDC

Following ADM Zukunft's visit, the Operational Commanders of Atlantic Area and Pacific Area, VADM William Lee and VADM Charles Ray, respectively, visited the Coast Guard RDC. RDC Project Managers spoke about some of the major efforts which the center is pursuing in partnership with operators to combat both emerging and persistent threats.



VADM Charles Ray (center left) and VADM William Lee (center right) address the RDC staff. At any given time, the RDC is executing more than 70 projects, and supporting operators in the fleet and decision makers at the Department of Homeland Security and Coast Guard Headquarters levels. The RDC is the only facility conducting research in support of all 11 of the Coast Guard's statutory missions.

Commandant of the Coast Guard Visits the RDC

On March 1, 2016, the Commandant of the U.S. Coast Guard, ADM Paul Zukunft, visited the RDC. After being greeted by the Commanding Officer of the RDC, CAPT Dennis Evans, and the Executive Director, Bert Macesker, ADM Zukunft met with several Project Managers and toured the facility. The Project Managers showcased various technologies which the center is evaluating, including devices for stopping non-compliant vessels, systems for locating hoax distress calls, and most notably, the CG Maritime Operational Effectiveness Simulation, which is being used to inform the multi-billion dollar Offshore Patrol Cutter (OPC) acquisition. RDC staff project presentations underscored the linkage of R&D investment in supporting all the Commandant strategies. Following his tour of the center, ADM Zukunft spoke to the staff, underscoring the importance of the RDC to a modern-day Coast Guard.



2016 APP — LCDR Sam Nassar leads an Assessment of Prospective Portfolio (APP) session. Representatives from multiple Coast Guard entities as well as DHS Homeland Security Advanced Research Projects Agency (HSARPA), DHS S&T Borders and Maritime Security Division (BMD), DHS S&T Office of University Programs (OUP), U.S. Customs and Border Protection (CBP), DHS Domestic Nuclear Detection Office (DNDO) and the Office of Naval Research (ONR) were in attendance to help prioritize the RDT&E Project Portfolio.



CG-STIC OPENING — RADM Thomas Jones gives remarks at the ribbon-cutting ceremony for the Coast Guard and DHS Science and Technology Innovation Center (CG-STIC). U.S. Representative Joe Courtney and New London City Mayor Michael Passero were among the attendees.



RDC Staff Perspectives

Several staff members shared their outlook with “A Personal Reflection: What It Means to Be Part of the RDC Community.”

The RDC is responsible for the development and execution of the Coast Guard’s R&D Project Portfolio. The RDC organization includes an Executive Director as well as Technical and Support Divisions that work together to execute the RDC mission. The Technical Division is responsible for planning and executing projects as well as providing science, technology and operational subject matter expertise. The Research Partnership Director facilitates joint engagement and shared research with a wide range of organizations. These experts include both military and civilian scientists, engineers, and analysts, many with advanced degrees in their respective fields. In addition to their formal educations, the people assigned to the Technical Division have a vast wealth of Coast Guard-specific knowledge and experience. Many are recognized experts in topics such as Search and Rescue, Oil Spill Response, Ballast Water Treatment, Automatic Identification System, Unmanned Systems, Arctic Operations, Marine Safety, Less-than-Lethal technologies, and Modeling and Simulation. The Technical Division is divided into five branches, based primarily on Program Areas.

The Support Division provides informational services; internet/intranet support; office automation; safety and security support; shipping and receiving; timekeeping; accounting services; marketing and public relations; property management; and general administrative support for the RDC and CG-926 organization.

The Program Office, CG-926, provides programmatic oversight and is responsible for policy, resources, strategic direction, stakeholder engagement, and communications to ensure the project portfolio is consistent with Coast Guard strategies.

CAPT Dennis Evans, Bert Macesker, and LT Keely Higbie provide information and guidance to visitors at the RDC.



New Director of Research Partnerships – Dr. Joe DiRenzo III

Dream job? Ask 50 people what that phrase means, and you will probably get 75 different answers. In my case, now serving as the Director of Research Partnerships for the Coast Guard RDT&E Program, I have found my dream job, in my dream location at the best command in the service.

What makes it a dream job ... five simple things. The mission, the engagement, the impact, the location and the people.

First, the mission. I am a recovering operator. With 14 years at sea and the past 15 years at Coast Guard Atlantic Area, in five different jobs, I know the importance that technology and innovation can play in mission completion. This job offers me a chance to do just that – leverage the greater academic and research community for the service.

Second, the engagement – on any given day I have an opportunity to engage with world-class academic leaders, cutting edge technologists, and experts at the country’s national labs, matching their research interests with USCG needs. No day is alike and every day offers an opportunity to truly marvel at the collective intellectual capacity of our nation.

Third, the impact that the R&D program has had and continues to have is significant. We touch all missions and always operate with the service’s strategies and deck plate operators in mind. There are few Armed Forces labs that are able to do it as well as we do.

Fourth, the location. Between my wife – who is a retired USN O-6 – and I, we have had six tours in the New London area. This is where we wanted to be once she retired. The opportunities are endless and the weather a perfect mix of four seasons.

Finally, the people. I have had the honor to serve at nine previous duty stations throughout my career in and out of uniform – each has been special, but the combined team at the RDC is unmatched. The single focus toward mission accomplishment, coupled with enthusiasm and motivation, is truly special. Combine these five elements together – you have a dream job.



RDC Technical Division Military – LT Carlton Brietzke Jr.

When I arrived at the RDC during the summer of 2015, I came with an extensive operational background and was excited to be here. Everyone I spoke with was excited to have me on the team due to my background and welcomed me with open arms. I must admit I was pretty nervous about my level of academic skills, given the vast knowledge and experience the RDC team possessed. I was up against a huge learning curve with some of the technology the RDC used. Now, a little over a year later, after meeting and building relationships with some tremendous teammates, I’m feeling comfortable in my role at the RDC, supporting team Coast Guard in the many aspects of the mission.

When shipmates ask me what it’s like working at the RDC, I lean on descriptors that most operators can easily understand. I describe the RDC in terms of a ship composed of several divisions and, like a ship, we all have one goal in mind – which is meeting mission. In order to accomplish our mission, sometimes we pull expertise from one division to work within another division that might be lacking a certain subject matter expertise. This is similar to shipboard life when Main Prop is painting the engine room, and a member of Deck Force is called upon to help mix the paint. To some, the RDC mission may seem somewhat less glamorous as we are not physically apprehending drug dealers or physically rescuing people from harm’s way, but certainly it is no less important. We are exploring, discovering, and inventing the tools our fellow Coasties require now and in the future.

A successful interdiction or life saved with any of the tools the RDC has transitioned to the field is not only a win for the RDC, but a win for team Coast Guard, and is something we should all be proud of. It is a privilege and an honor for me to work alongside such incredible people and I am truly humbled by the tremendous work that has been and is being accomplished at the RDC.



RDC Technical Division Civilian – Kurt Hansen

I first became familiar with the U.S. Coast Guard as a member of the Academy class of 1977. That did not work out but I finished an undergraduate degree in Mechanical Engineering and started on a Master's in Ocean Engineering before serving at the RDC for a one-year temporary position in 1980. I returned to the RDC in 1993 after nine years as an acoustics engineer and a U.S. Navy SCUBA diver at the Naval Undersea Warfare Center here in New London and a short stint as a contractor.

I have worked on marine inspection issues, test and evaluation of the 47-foot Motor Life Boat, risk-based decision-making, Harbor Safety (after 9/11), Oil Spill Prevention and Response and Aids to Navigation. Since the entire Coast Guard is the RDC laboratory, taking equipment into the field is a prime task. I have traveled to inspections on a "Laker" in Erie, Pennsylvania, and a barge in New Orleans; mothballed ships in Philadelphia; and visited CG stations in Tillamook, Cape May, and Gloucester. I have deployed equipment on the Columbia and Illinois rivers, New York harbor, Newport, Rhode Island, and Martha's Vineyard on buoy tenders and inland river tenders. Recently, I have had the opportunity to lead tests on the Great Lakes during the winter and deploy equipment off the Coast Guard Cutter Healy north of the Arctic Circle. I have also accumulated about 6 months at Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT, a Bureau of Safety and Environmental Enforcement outdoor tank test facility) deploying prototype equipment and another couple of weeks at the RDC Joint Maritime Test Facility (JMTF) in Mobile, Alabama, conducting burns. I have interacted with national and international partners at conferences in North America and Europe and worked with the International Maritime Organization (IMO) in London. During the response to the Deepwater Horizon spill, I spent half of the summer evaluating many of the 43,000 ideas sent in by the public.

The highlights of this job have been the projects and the locations as I described but, most importantly, the people. I have had the opportunity to work alongside district, sector, National Strike Force (NSF), CGHQ, and commercial, federal and state responders. Working at RDC has provided opportunities I never envisioned. The people here and in the Coast Guard have made the experience more fun and satisfying.



RDC Support Division – Guy Cranfill

Throughout my Coast Guard career, I have spent much of my time supporting the Coast Guard's various missions. Whether it was as a Telephone Technician repairing teletypewriters in the 17th Coast Guard District, servicing small boat stations and Aids to Navigation in the 5th and 9th Coast Guard Districts, or as an Independent Duty Technician on Coast Guard Cutter Hamilton, the most rewarding tours were those where I had a hand in accomplishing the missions or supporting the crew.

My work at the Coast Guard RDC has allowed me to continue this work through ensuring our IT systems are operated in a safe and secure manner, assisting other Coast Guard units in complying with Coast Guard IT policy, and advising fellow staff members on the proper handling of sensitive information.

While working at the center, I have been able to assist in field operations for the next generation of visual distress signals (flares) and deploy on detail assignments to Coast Guard Security Center, the Cyber Crisis Action Team, and the Plum Island Animal Disease Center (PIADC). During these assignments I assisted USCG Security Center (SECCEN) with clearing a massive backlog of security packages, helped Sector Europe with its accreditation, and assisted the PIADC Information System Security Officer (ISSO) in continual authorization activities.

In addition to my normal duties as ISSO, Classified Materials Control Officer, and managing Sensitive but Unclassified information, the RDC has allowed me to grow personally and professionally, completing my Master's Degree in Information Technology. Additionally the center has allowed me considerable flexibility in completing the prestigious U.S. Department of Agriculture Executive Leadership Program as well as attending other continuing educational opportunities.

RDT&E Program Perspective



Holly Wendelin— C4ISR Domain Lead (CG-926)

I first became aware of the Coast Guard's R&D Program when I was a LTJG back in 2003. I visited the R&D Center at the old University of Connecticut's Avery Point location while I was serving as the co-chair on the Coast Guard's Underwater Port Security Working Group. I remember visiting lab space and seeing some of the underwater vehicles that they were testing to see which would best support the needs of the Coast Guard for monitoring underwater areas in ports. I remember thinking how cool it would be to work there, evaluating different cutting-edge technologies and developing a few of our own.

A year ago I came to the RDT&E program from the Navy's LCS Mission Module program. All these years later, I am just as impressed by the breadth of research that we are conducting and the in-house expertise that the R&D Program has to offer. I bring with me an operational background in the Coast Guard as well as Acquisition and combat systems testing and evaluation. Never in a million years did I think that my specific blend of expertise would be so useful to any single job, but I am able to apply all of my previous experience to getting the job done with the R&D Program. Coming back to the Coast Guard after working as a contractor and then for the Navy has been like a homecoming. I fell right back into step with my old service and the goals that we all share – accomplishing our 11 statutory missions as effectively as we can.

As the C4ISR Domain Lead, I feel personally responsible for ensuring that the right ideas get funded for research by building professional relationships with stakeholders across headquarters and within the greater Coast Guard community. Every research project we begin is tied to at least one mission and Commandant Strategy. We ensure that the work and results from each project is sponsored by a headquarters Program Office and has the potential to be used by Coast Guard operational units. I love connecting programs to research and answering the needs and gaps that the men and women of the Coast Guard bring to us.

I have witnessed first-hand how the R&D Program can influence mission accomplishment for the greater good. I have enjoyed my first year here tremendously and I am proud of the work that the Coast Guard R&D Program does for our service. I look forward to many years of sharpening the edge of the Coast Guard through the R&D Program.

RDT&E Partner Perspective



**Matthew Clark – Director, Office of University Programs
DHS Science & Technology Directorate**

I wanted to provide some long overdue kudos to you, the Research and Development Center and the U.S. Coast Guard, for expending the time and effort to develop a solid working relationship with the Science and Technology (S&T) Office of University Programs (OUP) over the past few years.

The RDC's engagement with OUP and the DHS Centers of Excellence (COEs) is a model of how an interagency collaboration should work. While OUP has expedited USCG's access to the COEs, their faculty and students, the RDC has patiently taught us (OUP and the COEs) how to make university research operational. The RDC has shown enormous patience with OUP and the COEs to work through multiple challenges of getting new technology into use. This includes everything from jointly managing projects through contracts and grants, teaching us the Coast Guard's organization and operations, participating in drafting COE Statements of Work (SOWs), helping us select the best performers, and working closely with the universities to ensure their research and development serves the DHS mission.

One example illustrates how well the relationship has worked. The Coast Guard, particularly the RDC and the Atlantic Area (LANTAREA), were willing to test a largely untried game theory-based tool, the Assistant for Randomized Monitoring Over Routes (ARMOR), to improve the deterrence effectiveness of marine patrols. Tests in Boston Harbor, and subsequently in New York, showed that the tool could be effective. The RDC took delivery of it, only to find it needed significant modification to be used on Coast Guard computer systems. The RDC assumed the challenges of adapting "gradware" to "userware," and in the process taught us how to do it right.

There have been many subsequent project interactions that have improved OUP's operations considerably. Thanks for working with us to establish the best interagency working relationship that I have experienced.

RDC STEM Interns

Each year the Coast Guard RDC recruits Science, Technology, Engineering, and Math (STEM) interns as summertime employees embedded within ongoing RDC projects.

From the RDC to working at a DHS S&T Laboratory



Excerpt from the National Urban Security Technology Laboratory (NUSTL) Newsletter

“Hasan Shahid interned at the United States Coast Guard RDC in 2015 where he developed a search and rescue exercise test plan for the Coast Guard’s Arctic Technology Evaluations, in addition to supporting many research activities and test evaluations onboard the Coast Guard Cutter Healy, the United States’ newest and most technologically advanced polar icebreaker.”

Hasan Shahid has since joined NUSTL as a contractor to support various programs and projects under NUSTL’s Test and Evaluation Division.

RDC 2016 STEM Interns



In addition to visiting several operational Coast Guard units and earning an Industrial Control Systems Cyber Emergency Response Team (ISC-CERT) certification during the Summer of 2016, Laura Ayres also designed and implemented a communications interface to integrate with the Radio Reconnaissance Technology’s Tactical Handheld Emitter Finder (THiEF) direction finding capability in support of RDC Project Hoax Location Systems and Methods. This effort laid the groundwork for a direct computer interface and ultimately saved tens of thousands of dollars in external development costs.

Another STEM intern, Erik Erdman, also earned an ISC-CERT and he researched the National Marine Electronics Association (NMEA) 0183 and 2000 standards from a cybersecurity perspective. As he became more familiar with the standards, he also researched and obtained freeware associated with the development and testing of NMEA 0183/2000 devices and networks and built a prototype network.

Individuals interested in this program may find out more information via: <http://www.orau.gov/dhseducation/internships/>. Unaffiliated universities with DHS Centers of Excellence have also embedded interns at RDC and are encouraged to continue to do so.

RDC Executive Director's Reflections

Bert N. Macesker

Reflections... This is my fifth year serving as RDC Executive Director. I enjoy my job because of the opportunities to improve mission performance with new technology and because I get to work with some of the most talented and dedicated military and civilian scientists, engineers, Project Managers, and support staff to both shape and execute the RDT&E portfolio. Each year we can tell a great return-on-investment story. CAPT Dennis Evans shared some of our key accomplishments in his opening message.

In May, we held a ribbon cutting that opened the joint Science and Technology Innovation Center (STIC) with DHS. The collaborative effort between the RDC and DHS S&T was conceived as a response to the DHS Secretary’s “unity of effort” initiative with the intent to more rapidly address emergent needs and transition technology and innovation to operators. The STIC will be fielding its first projects in early 2017 and there are several other tasks cued up.

In August, we released our 2017 RDT&E Project Portfolio. The portfolio includes 69 ongoing and many new projects. New projects include CubeSat technology research, developing a mass migration decision support tool, finding technology solutions to counter growing concerns with small unmanned aerial systems (sUAS), and evaluating the use of cell phone geo-location technologies for Search and Rescue. The CubeSat project is a great example of a co-funded partnership with DHS S&T with many interested stakeholders. CubeSats are less expensive to build, launch, and operate than conventional satellites and facilitate a more rapid deployment of capabilities. The addition of two new RDC command and control stations to the growing network across the U.S. this summer will be used to track and collect information from CubeSats that will detect Emergency Position Indicating Radio Beacon (EPIRB) emissions. Testing the waters (or space in this case) with the introduction and Coast Guard application of new technology is a great strategic use for the RDT&E Program before any investment in formal programs.

While it is our current dedicated and experienced military and civilian “workforce” working together with Program Sponsors, partners, and operators that determine our success in executing the RDC mission, I want to mention our efforts to build reputation in the academic community to attract the “new workforce.” We started internships as a trial balloon a few years ago through the HS-STEM program. Since then the RDC STEM hosting reputation has grown to the point where we now have to turn away placement requests from universities. No surprise – students want to be part of the



interesting technology research we do in support of Coast Guard missions. The FY17 intern topics include counter-UAS, Arctic operations, CubeSat technology, small sUAS electronic operator visors, and cyber security.

Looking Ahead... I make my “to-do” list every day I come in to work. This helps me focus on my day job but this list is by no means a strategy. It can become easy to get trapped in a rut of reacting to and chasing after technology solutions to near-term tactical problems. That is why our “to-do” list must also facilitate Coast Guard long-view investments in science and technology, innovation, and research. As we continue to stretch our budget, I see that the majority of problems presented will still be addressed by in-house project execution with in-house staff expertise. We have the best problem solvers and hands-on innovators armed with Coast Guard operational knowledge. However, we are also increasing our role as science and technology advisors and identifying worthy leveraging opportunities. We have a growing list of projects directly linked to external partners. Seeking out partnerships with the private sector, academia, national labs, and Other Government Agencies (OGAs) will be a continuous component of our RDT&E business model. We can offer partners challenging maritime domain research problems and an organization that from senior leadership to the operator, appreciates the contribution of technology and innovation to Coast Guard operations.

Together with an energized Program Office, along with our partners, stakeholders, and, most importantly, Coast Guard customers, the RDC will continue to serve as a strategic science and technology resource for the Coast Guard.

RDC Local Outreach

CG Academy (USCGA) Operations Research Cadets Visit the RDC



Coast Guard Academy Operations Research Cadets were provided a tour of the RDC in September 2016. The tour included an in-brief from the Technical Director, Tim Girton, which was followed by visits to the Project Exhibit area, the AIS/Photonic Laboratory, the Modeling & Simulation Center of Expertise, and the collocated Coast Guard units, the International Ice Patrol and the Marine Safety Laboratory.

Feds Feed Families

Launched in 2009 as part of the President's "United We Serve" campaign, the Feds Feed Families program is designed to help food banks and pantries stay stocked during summer months when they traditionally see a decrease in donations and an increase in need. The RDC is a leader in the S.E. Connecticut Feds Feed Families campaign. In 2015, the RDC donated over 800 pounds of food to local food banks, more than tripling the RDC goal. During a 2016 gleaning event at the Coogan Farm Giving Garden in Mystic, Connecticut, participating RDC members harvested over 700 pounds of produce, all of which benefit the Gemma E. Moran United Way/Labor Food Center. This center distributes food to 63 programs that serve 91 feeding sites across New London County. In total, the RDC more than doubled the 2015 donation by providing 1,600 pounds of food to the Feds Feed Families program in 2016.



From left, RDC Executive Director Bert Macesker, Commanding Officer CAPT Dennis Evans, John R. Freda, RDT&E Program Manager Wendy Chaves and Deputy Assistant Commandant for Acquisition James Knight show off some of the food the RDC collected.

Toys For Tots



The RDC joins the U.S. Marine Corps Reserve Toys for Tots program to collect new, unwrapped toys during November and December to distribute as Christmas gifts to less fortunate children throughout the United States. Each year the RDC donates at least a minivan full of toys that helps to brighten Christmas for many local children.

Partnership in Education (PIE)

Interdistrict School for Arts And Communication (ISAAC) Program

Goal: RDC personnel interact with every grade at the ISAAC School

For the fifth consecutive year, the RDC has maintained a strong partnership with the ISAAC school in New London, Connecticut. At the beginning of each school year, the RDC's PIE representatives work directly with the ISAAC faculty and staff to tailor RDC interactions with the students to the state's evolving learning objectives while maintaining a focus on the Coast Guard's missions and core values. Examples of this past year's activities include: the examination of the role humans play in climate change – pros and cons of Rhode Island wind farms; equipment design to help survival in the Arctic – dry/wetsuits; design construction of a Trebuchet; and rocket day – where students construct their own soda bottle rockets and get some hard lessons in aerodynamics and construction quality.



LT Chuck Clark explains some of the technology on display at the RDC during the visit from ISAAC school students.



John McLeod explains about the Zero Length Mirror to students during their visit to the RDC Light Tunnel Laboratory.



Students test their Trebuchet Designs produced under the guidance of the RDC engineering staff.



William Lizik demonstrates the tools and explains the functions of the Coast Guard Marine Safety Laboratory (MSL) which is collocated with the RDC in New London. Students from the Interdistrict School for Arts and Communication (ISAAC) toured the MSL as part of STEM outreach.



More details regarding these events and other work done by the RDC can be found on the CGPortal or by sending an email request to: RDC-Info@uscg.mil/United States Coast Guard



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