

Naval

Undersea

Warfare

Center

Division

Newport



1997 S C I E N C E

TECHNOLOGY

Science and technology (S&T) are central to the goals of economic security, military strength, and diplomatic engagement — the vital elements of national security. The wisdom of our investments in S&T will significantly affect our ability to meet our national security challenges as we move into the next century. International cooperation in S&T serves to prevent and mitigate threats to society, increase exports of U.S. technologies, and promote sustainable development.

— *William J. Clinton*
March 20, 1996

We must strive to reap the benefits of the ongoing technology explosion, and to gain greater efficiencies in warfighting.

— *General John Shalikashvili*
Chairman, Joint Chiefs of Staff

Increasingly, we need to monitor that progress and do selective cooperative technology development. We are past the time when the U.S. alone can dominate science and technology.

— *Anita K. Jones*
Director of Defense Research and Engineering

A continuing flow of new technology is the foundation of our future technological superiority, as well as supporting our ongoing affordability and Fleet modernization efforts. The goal of the Department of Defense's science and technology program is to develop and improve technologies critical to advanced naval warfighting capabilities, platforms, and weapons. Our new challenge is to find and provide affordable options for projection of naval power without compromising or jeopardizing technological superiority today or in the future.

— *John W. Douglass*
Assistant Secretary of the Navy



Dr. John E. Sirmalis
Technical Director
Naval Undersea Warfare Center

Since the end of the Cold War the Navy has been charting a course away from global superpower conflict, steering instead toward building a Navy that is optimized for regional conflict and operations in littoral waters. New defense strategies are being developed to respond effectively to these potentially dangerous regional conflicts, which one would expect to be fought with very sophisticated weapons. The Naval Undersea Warfare Center's scientists and engineers are responding to the new challenges posed by this rapidly evolving threat environment, inventing new devices, designing new systems, and improving existing systems to give our Navy's ships and sailors a defense capability unmatched by any other nation.

From its inception as the Naval Torpedo Station just after the Civil War, the Newport Division of the Naval Undersea Warfare Center (NUWC) and its predecessor organizations have garnered over 127 years of experience in the discipline of undersea warfare. We have seen an evolution in our mission from being strictly torpedo-oriented to one where we are now the nation's premier resource for all undersea warfare technologies. Our nation's leaders recognize that the Navy's Undersea Warfare capabilities will remain vital to meeting our national defense needs for the foreseeable future. For decades our work has been tailored to meet the demands imposed by the Cold War, but these have now evolved to meet the new challenges we face in the littoral, at a time when our responsibilities to the taxpayer have never been more visible.

The men and women of NUWC have responded to these challenges with a vigor and level of commitment that has been second to none. This "can-do" attitude has always been a hallmark of our personnel and has resulted in a reputation for excellence within the Naval Sea Systems Command. This record of achievement, coupled with fiscal responsibility, will keep the Naval Undersea Warfare Center at the forefront of NAVSEA's efforts to "reshape our course ...to the future," as we continue our mission of advancing the state of the art in all undersea warfare technologies.



Mr. Juergen G. Keil
Executive Director
Naval Undersea Warfare Center, Division Newport

Since World War II, owning the technology advantage has been a cornerstone of this nation's military strategy. The technology advantage we enjoyed in Desert Storm reflects a legacy of decades of investment in science and technology. Likewise, our future warfighting capabilities will be substantially determined by today's investment in S&T.

A nation can't buy off-the-shelf or out of a catalog and maintain technological superiority. Military advantage lies in riding the technology curve, and this will be assured only if the industry that is riding the curve is available to work with the military and directly serve the warfighter's needs.

Key players in the research community — universities, government laboratories, and industry — will increasingly be working together, developing partnerships and using existing resources more efficiently. Dual-use technologies — those that have both commercial and defense applications — will advance the nation's economic security by helping to create a single industrial base that can satisfy both defense and commercial needs. These technologies will also allow the Pentagon to realize economies of scale in a time of continuing shrinkage in defense budgets.

NUWC Division Newport scientists and engineers provide the technical expertise to enable the Navy to be a smart buyer and user of new and upgraded undersea warfare systems and support capabilities. We are committed to reducing acquisition and life-cycle costs, developing dual-use technologies, rapidly transitioning and inserting new technologies during all of a system's life cycle, and maintaining the long-term technology base for undersea warfare.

Contents

Science & Technology Strategy

Division Newport is a vital link to the DoD commitment to S&T, contributing to a strong U.S. technology base while reducing life cycle costs.

4

Applied Research

Division scientists and engineers build on basic research to develop future technologies. Most of the true innovations in naval platforms have either originated or been strongly nurtured in Applied Research.

8

Awards Recognition

Members of the Division continually have been recognized with prestigious national awards, honoring dedication and achievement in areas of science and technology.

9

Basic Research

The Division's Independent Research program provides a strong foundation for the next generation of technologies, focusing on research areas for Navy investment.

10

Advanced Technology Development

The Division participates in accelerating critical technologies not ready to transition to the Fleet. These demonstrations provide high payoff with medium-to-high technical risk.

12

Workforce

The future of science and technology for our Division relies heavily on the expertise, skills, inventiveness, and dedication of our workforce.

14

Facilities

The Division boasts a wide range of unique and state-of-the-art facilities and capabilities. Highlighted are the Acoustic Wind Tunnel, the Acoustic Test Facility, and the Advanced Scientific and Engineering Computational Center.

16

Dual Uses & Technology Transfer

Many of the Division's technologies, including torpedo sonar, signal processing, and sensor measurement, have had very successful dual-use applications.

20

Moving Forward

Experience and a balanced approach combined with aggressive qualitative and quantitative forecasting are key ingredients of Division Newport's formula for past and future successes in undersea warfare.

24

Technology & Excellence



Research

Science & Technology Strategy

Through all the changes that have transpired in the U.S. military environment over the last few years—the collapse of the Berlin Wall, the shift from deep water to littoral, funding cuts, and BRAC consolidation actions—one thing has remained constant: the need for, and the Pentagon’s commitment to, maintaining technological superiority.

Technological superiority involves leveraging technology and adapting it to military needs as it becomes available. The challenge is to transition affordable technology into capabilities faster than that technology becomes available in the international market.



Stealth Sail model with design team



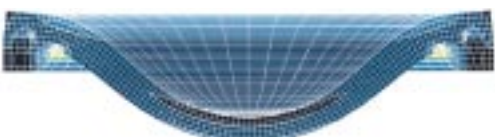
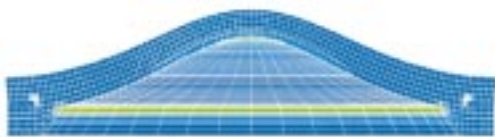
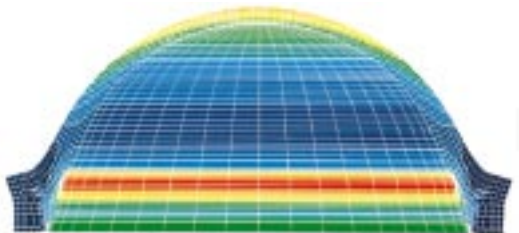
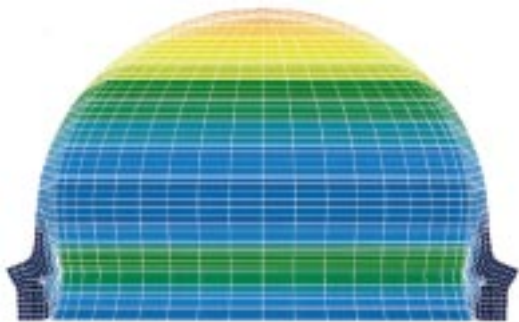
The Department of Defense continues to place major emphasis on science and technology – the “front end” of the research, development, and acquisition process. This emphasis is further heightened in an era that demands balance between maintaining technological superiority and reducing life cycle costs.



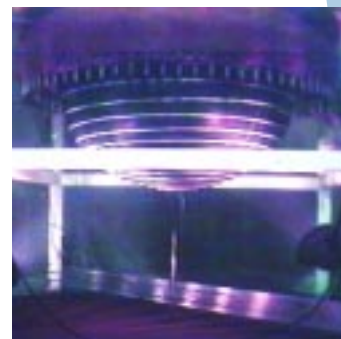
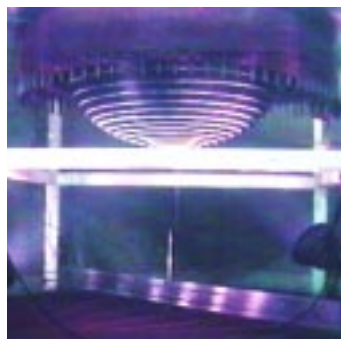
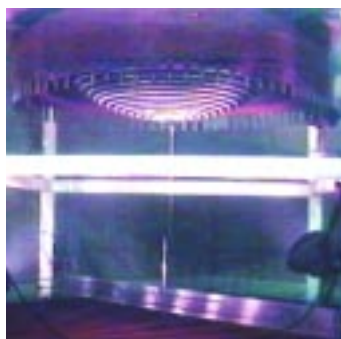
Division Newport's Science and Technology Program is aggressively pursuing the challenges of incorporating these capabilities to improve performance in the complex environment of the littoral. Concurrently, the Division is approaching affordability as part of the technical foundation of new development.

Joint, multinational operations focus importance on communications, interoperability, and overall systems flexibility. Division Newport's Science and Technology Program is aggressively pursuing the challenges of incorporating these capabilities to improve performance in the complex environment of littoral waters. Concurrently, the Division is approaching affordability as part of the technical foundation of new development.





Numerical simulation and video captures of elastomeric accumulator dynamics



There is no doubt that maintaining a strong technology base is crucial to maintaining U.S. military superiority. The Division's Science and Technology Program, which consists of Basic Research, Applied Research, and Advanced Technology Development, is a large part of that technology base: S&T projects account for a highly visible 10 percent of the Division's workyears.

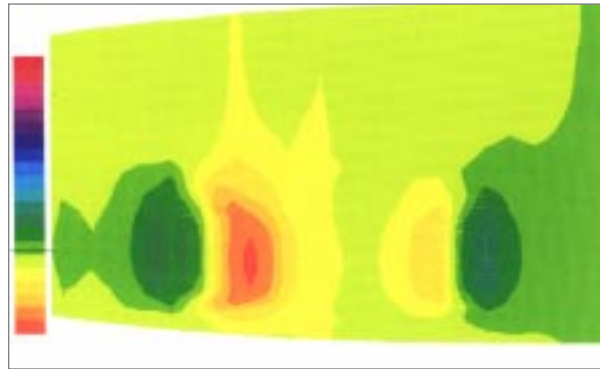
S O

One big push in the defense community is utilizing state-of-the-art commercial-off-the-shelf (COTS) equipment and components. In the area of undersea warfare science and technology, however, there is a continuing requirement for highly specialized people to conduct specialized and unique research. Researchers at Division Newport have turned to sharing technology with industry in joint partnerships called CRADAs — Cooperative Research and Development Agreements — and through formal technology licensing. The focus is on exploiting technologies that could have applications to both military and commercial areas.

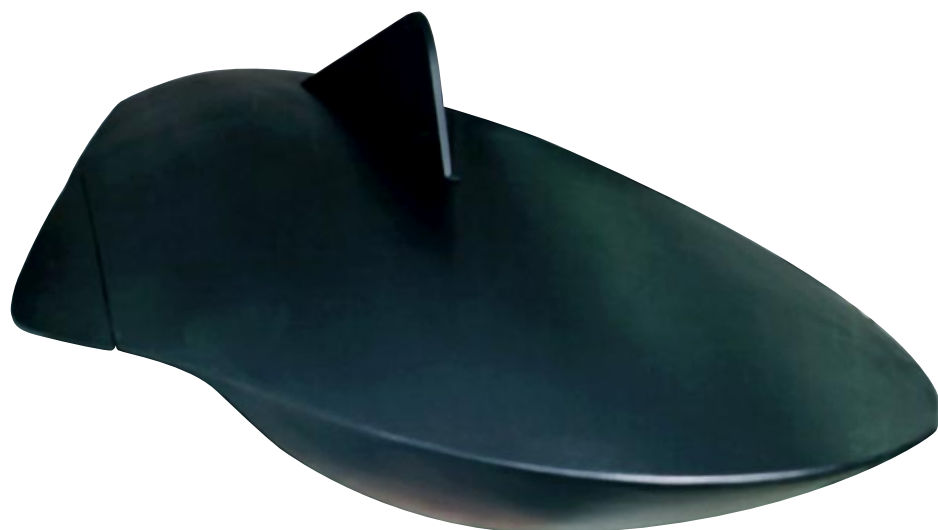
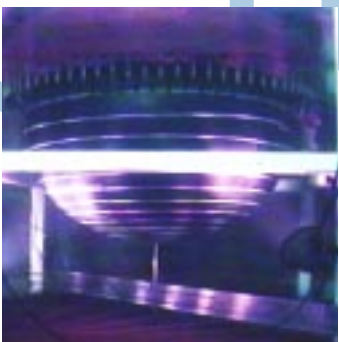


SEAWOLF in Electric Boat dry dock (above)

Pressure distribution over Wide Aperature Array (right)



ciencia

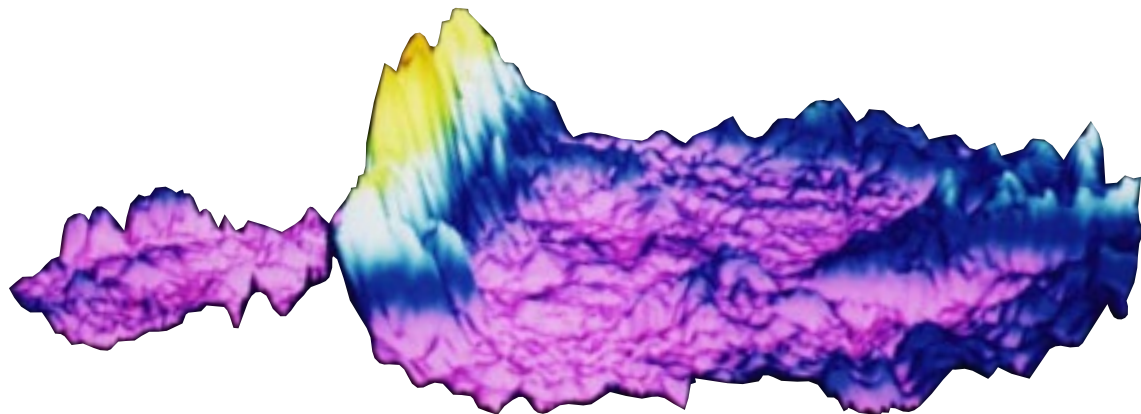


Basic Research

Basic Research (6.1) is the foundation for the next generation of technologies, producing knowledge in the physical, engineering, environmental, and life sciences. In addition to universities and industry, DoD laboratories perform research and form a very important part of the national technology base. Predictions concerning technological capabilities that might prove most valuable, and information concerning associated problems, are essential in selecting the appropriate research areas for investment.

Basic Research (6.1) is the foundation for the next generation of technologies, producing knowledge in the physical, engineering, environmental, and life sciences. In addition to universities and industry, DoD laboratories perform research and form a very important part of the national technology base.

Because research is a long-term investment, and because there are constantly changing technologies to be explored and investigated, research has continued to be a priority despite decreasing defense budgets. In these times of leaner budgets, four general considerations are used in decisionmaking: affordability, dual-use application, rapid transition to the Fleet, and maintaining a strong technology base. There are two programs dealing with research at Division Newport: Basic Research (funded directly by the Office of Naval Research (ONR)) and Independent Research (IR) (an in-house managed program). The Division's IR program accounts for most of the basic research performed. Funding of IR projects is the result of an in-house review and selection process in which the major criteria include



the project's relevance to the Division's mission and technical quality. Focus is also put on dual-use applications and strengthening of the Division's core competency areas. These IR projects enable the exploration of emerging technologies, some of which are high-risk/high-payoff in nature, for long-term application to core mission areas. The IR program has had an excellent history of transitioning developments into applied research and Fleet systems.

$$\rho \nabla \cdot \left[\frac{1}{\rho} \nabla P(r) \right] + k^2 P(r) = -\delta(r - r_s)$$

Applied Research

Applied Research (6.2) represents the advancement of technologies necessary for the realization of advanced systems. It is a functional phase that includes efforts, except for major development efforts, directed toward the solution of specific military problems. These projects vary from fundamental applied research to development of sophisticated breadboard hardware and prototype systems. The objective is to develop the mature technologies needed to allow the Navy to meet current and future threats in a constantly changing global environment.



Applied Research projects may also include proof of concept experiments and evaluations of models and laboratory experiments. The Applied Research program provides the vital transition from products of basic research to projects with useful applications. Most of the true innovations in naval platforms have either originated or been strongly nurtured in Applied Research.

The Division's Applied Research programs in undersea warfare (USW) are focused on four leadership areas. The Submarine/Surface Ship USW Surveillance area has six technology thrusts: active sonar, deployable surveillance, nonacoustic sensors, full-spectrum processing, interoperability/data fusion, and sensors/arrays. The Submarine Combat and Combat Control Systems area has technology thrusts of command and control for self-defense, automation and decision aids, and littoral warfare contact management. The Submarine-Unique Communications, Electronic Support Measures (ESM), and Electro-Optics area has joint interoperability and communications at speed and depth for its technology thrusts. The Undersea Weapons, Unmanned Underwater Vehicles (UUVs), Targets, Launchers, and Countermeasures (CMs) area has thrusts in torpedoes, unmanned underwater vehicles/targets, torpedo acoustic countermeasures, and submarine launchers.

Advanced Technology Development

Advanced Technology Development (6.3) is used to mature technologies that are not ready to transition directly into validation and verification or engineering development (6.4 and 6.5). This phase is broken into two parts: Core and Advanced Technology Demonstrations (ATDs). Core 6.3 efforts are longer term efforts (four to five years or longer) that continue the logical maturation of 6.2 technologies that will yield critical new capabilities for the Navy.

ATDs are typically three-year programs that transfer critical technologies into realistic operating environments. These narrowly focused demonstrations identify technologies that are ready to be transitioned into the Fleet and define performance parameters. By definition, ATDs have medium-to-high technical risk and are high-payoff in nature. By closely monitoring the execution of ATDs and

evaluating the success of the demonstrations, the Navy greatly reduces the risks associated with procurement of systems containing highly advanced technologies.



High resolution sonar array mounted on Towed Data Acquisition System (TDAS) (above)

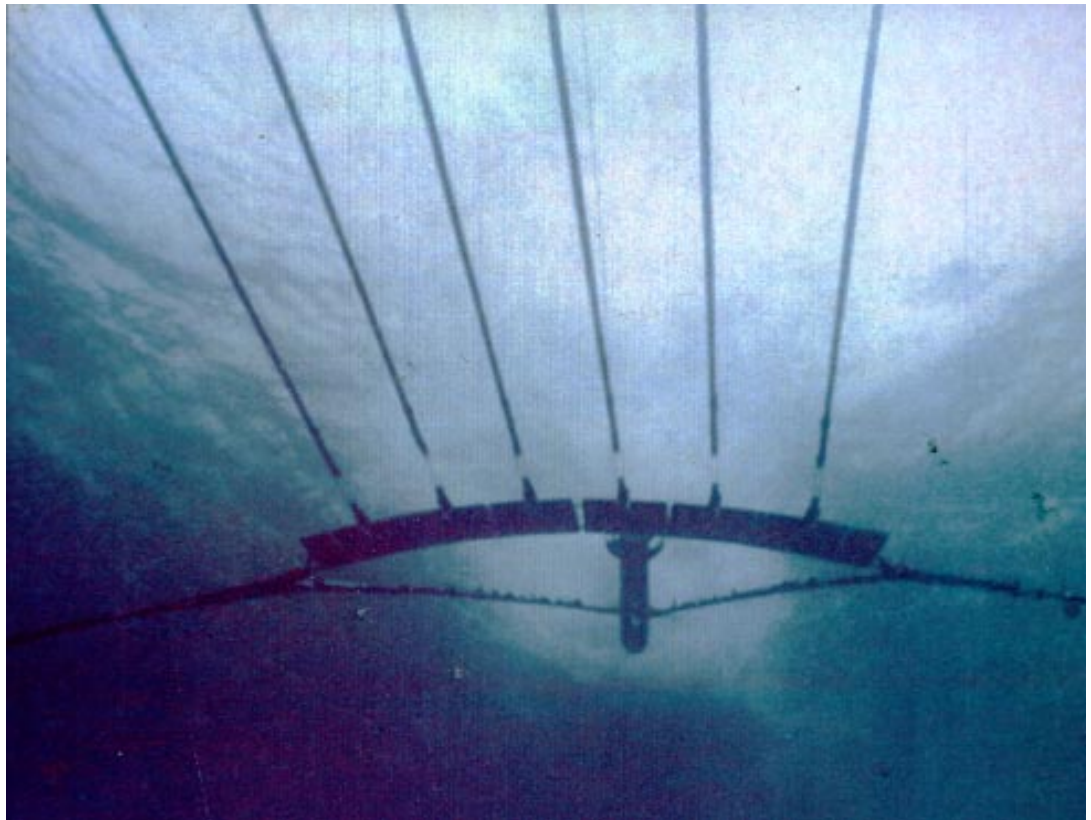
MIT's Odyssey testing in the Anechoic Chamber (right)



tech

A recent transition was Division Newport's Lightweight Planar Array technology, which has been applied to the AN/BQG-5 Wide Aperture Array (WAA) sonar panels. It reduced the weight of the array panels by 54 percent (compared with the original WAA Engineering Development Model), and acquisition cost savings of 37 percent are expected.

Ongoing ATDs at Division Newport include Shallow Water Torpedo Guidance and Control, Submarine SHF Phased Array Antenna, and Advanced Technology Tactical Acoustic Communications. The Shallow Water Torpedo Guidance and Control ATD addresses deficiencies in MK 48 ADCAP and MK 50 torpedo performance in shallow water. The expected payoff is a doubling of detection performance and the ability to classify and home on threats in cluttered, noisy environments. The Submarine SHF Phased Array Antenna will support two-way high data rate submarine communications. The Advanced Technology Tactical Acoustic Communications ATD, by employing an DARPA-funded technology (joint channel estimation and equalization), provides exponential improvements in underwater acoustic communications.



Multi-Line Towed Array dynamics

Future ATDs will continue to develop undersea warfare technologies in the areas of weapons, communications, remote sensors, and fiber optic acoustic technology. For example, the Affordable Array Technology ATD involves an Ultra Thin Array that uses a single commercial fiber optic cable without splices, couplers, reflectors, etc., to provide an acoustic line array.

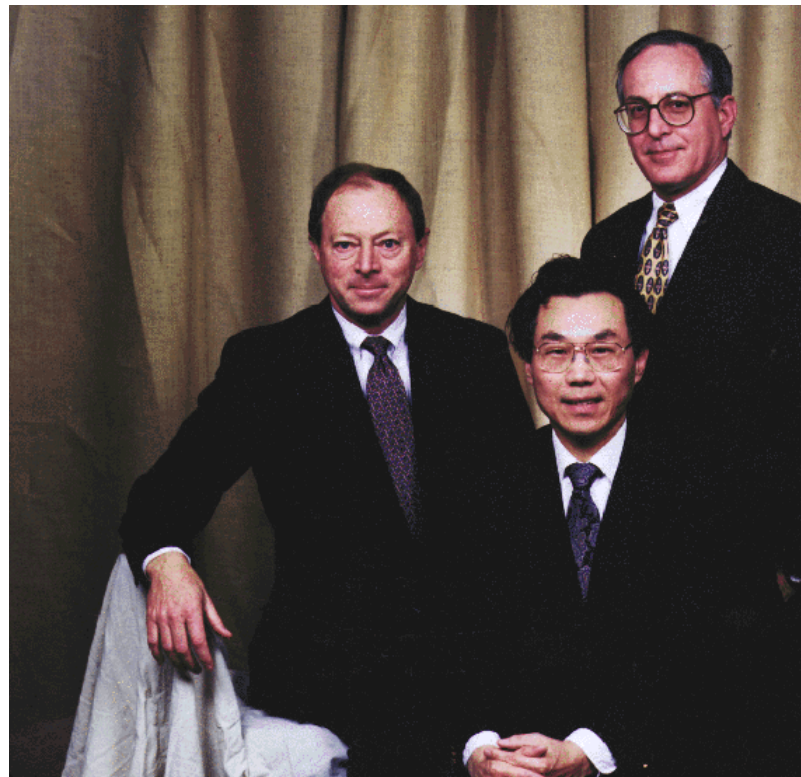
technology

Awards Recognition

The Division's personnel receive numerous awards and recognition at the local, national, and international levels.

Two of the Division's scientists have received the prestigious Naval Sea Systems Command Scientist of the Year Award in recent years. Dr. Norman L. Owsley was honored in 1995 for his achievements in signal processing improvements in both underwater acoustics and bioscience. In 1996, the award went to Dr. Albert H. Nuttall for his contributions in communication theory and signal processing. Dr. Nuttall's work has had a major impact in the field of spectral analysis of stationary multivariate processes, both by fast Fourier transform processing and by the newer linear predictive technique.

*ADPA Bronze Medal winners
Mr. Eric V. Swanson, Dr. James C. S. Meng,
and Mr. Frederick C. Allard*



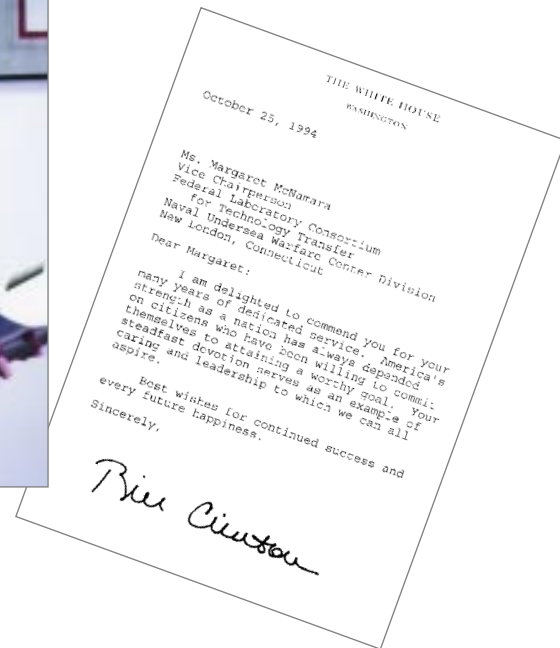
Dr. Howard H. Schloemer received the 1997 VADM Charles B. Martell Award for his contributions to the U.S. Navy's submarine sonar capabilities. A pioneer in the development of externally mounted arrays, his research has led to sweeping changes in submarine sonar designs, changes that are being incorporated in the latest classes of submarines. His investigations provided the experimental basis for calculating the effects of roughness, pressure gradients, elastic covering over a hydrophone, and hydrophone size and shape on the reduction or amplification of turbulent boundary layer pressure fluctuations. Among Dr. Schloemer's many contributions to sonar technology, his leadership in the development of the Wide Aperture Array stands out as one that will most significantly and positively impact USW technological superiority.

In 1996, Dr. Norman L. Owsley and Dr. Bruce E. Sandman were recipients of the American Society of Naval Engineers Awards. Dr. Owsley was selected to receive the Society's Gold Medal for Engineering for his efforts in the development of advanced towed sonar array technology and for his pioneering work in adapting this technology for non-invasive medical imaging purposes. Dr. Sandman was selected to receive the Solberg Award for his research and achievements in structural mechanics and acoustics and their relationship to quieting small undersea vehicles.





Ms. Margaret M. McNamara,
Technology Transfer Manager



The Division's Technology Transfer Manager, Ms. Margaret M. McNamara, received an Award of Appreciation in recognition of her 14 years of outstanding service as vice chairperson of the Federal Laboratory Consortium and her commitment and dedication to establishing partnerships between government laboratories and industry. Along with the award, Ms. McNamara received letters from President Clinton and Secretary of the Navy John Dalton commending her success and encouraging her future leadership in the area of technology transfer.

In 1996, three Division employees received the American Defense Preparedness Association's Bronze Medal. Mr. Frederick C. Allard, Dr. James C. S. Meng, and Mr. Eric V. Swanson were awarded the medal for their individual contributions to the U.S. undersea warfare community. The trio was cited as "dynamic and talented employees who are influential in shaping the future capabilities of the submarine force."



Dr. Albert H. Nuttall
receiving the 1996
NAVSEA Scientist
of the Year Award

Naval Sea Systems Command Scientist of the Year
Award • Award of Appreciation • American
Defense Preparedness Association's Bronze Medal

The Division also maintains its own internal Annual Awards Program, which recognizes outstanding performance across all areas, from management to support services. Excellence awards are given in the areas of science, engineering, and invention and licensing. The IR program presents an award for the most creative, innovative, or productive IR project for the preceding year. Long-term outstanding contributions are frequently rewarded; for example, the Decibel Award, one of the Division's oldest awards (dating back to 1945) is presented for distinction in sonar and underwater acoustics. The Division has also established seven Distinguished Chairs in Science and Engineering to honor superior scientific and engineering accomplishments, as judged by a group of peers and endorsed by management.

Workforce Workforce

Division Newport has a long history of recruiting bright and motivated individuals. Currently, the Division has more than 3300 dedicated and enthusiastic employees, the majority of whom are scientists and engineers. Approximately 40 percent of the 2178 scientists and engineers employed at the Division have graduate degrees, including 154 PhDs.

To ensure continuing superiority in its assigned leadership areas, the Division maintains preeminence in a number of key disciplines or “Spheres of Excellence.” These spheres help to navigate the Division as a research and development corporation, establish hiring and training criteria, and provide corporate guidance for S&T investment strategy.



To maintain its exceptional workforce, the Division encourages professional development through funding and mentorship programs, continuing education and training programs, and promotional opportunities for technical experts. The Division started a patent initiative in 1988 that has had tremendous success in prompting inventors to disclose and patent their ideas. The number of annual disclosures has grown from approximately 20 in 1988 to 169 in 1996. In FY96, the Division led the Navy in all three of the major creativity metrics. The 169 disclosures submitted, 161 applications filed, and 86

E

O

N

E

E

O

X

E

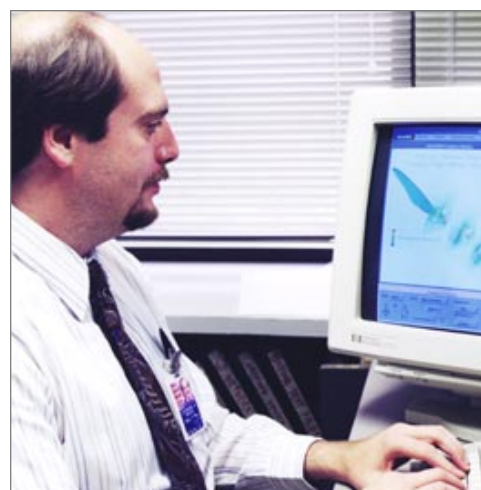
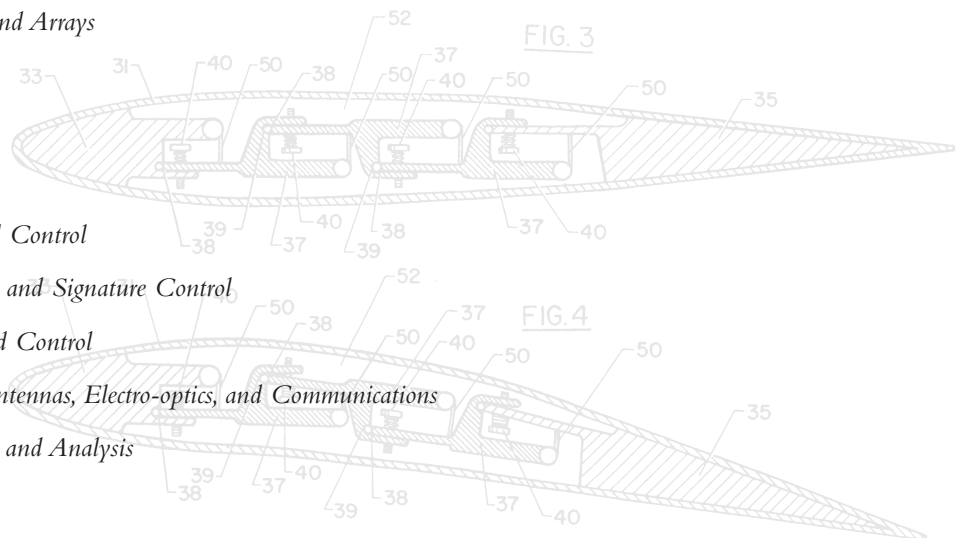
patents issued represent 25.7 percent, 39.6 percent, and 29.0 percent, respectively, of the entire Navy output in these categories. The Division's number of disclosures per scientist and engineer is the highest of all government agencies. The Division has one license covering a group of five patents on a submarine antenna system. Between \$15,000 and \$20,000 in royalty payments has been received to date, all of which has been designated for the inventors.



Spheres of Excellence

- *Acoustic Sensors, Transducers, and Arrays*
- *Signal Processing*
- *Structural Acoustics*
- *Information Processing*
- *Weapon Systems Targeting and Control*
- *Torpedo and UUV Propulsion and Signature Control*
- *Undersea Vehicle Guidance and Control*
- *Submarine Electromagnetics, Antennas, Electro-optics, and Communications*
- *Warfare Modeling, Simulation, and Analysis*
- *Hydrodynamics*
- *Ocean Physics*
- *System Engineering/Cost and Operational Effectiveness Analysis (COEA)*
- *Undersea Range Technology*
- *Large Scale Numerical Modeling and Analysis*
- *Undersea Materials Technology*

U.S. Patent May 19, 1992 Sheet 2 of 2 5,114,104



Facilities Facilities

The Division has an impressive array of research facilities and test and evaluation ranges to maintain excellence in undersea science and technology. These state-of-the-art resources are continually

maintained and upgraded to meet the changing needs of the defense

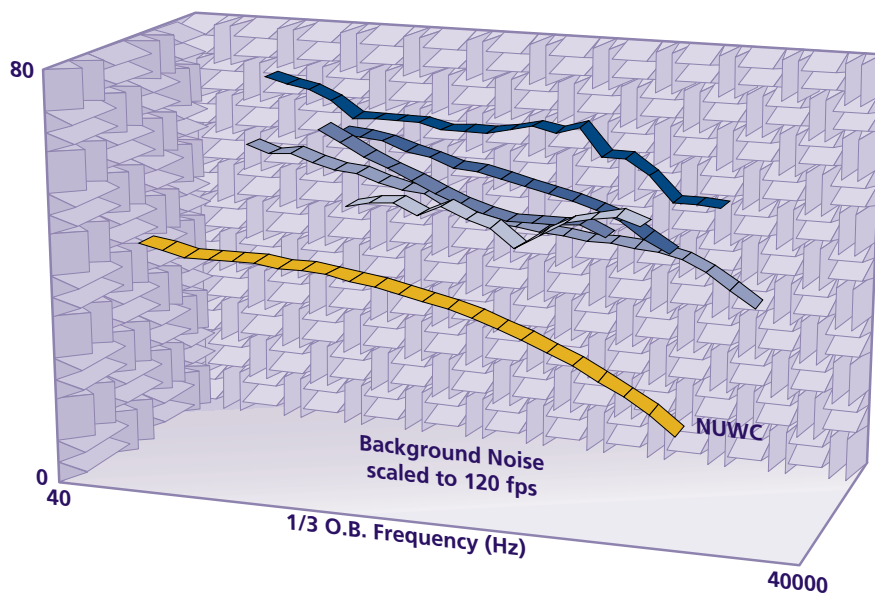
The Division has an impressive array of research facilities and test and evaluation ranges to maintain excellence in undersea science and technology. These state-of-the-art resources are continually maintained and upgraded to meet the changing needs of the defense community. As the Division gets smaller, it becomes increasingly important to maintain excellent facilities that are fully utilized.

Division Newport's unique test centers for acoustics, communications, and propulsion research and development have been utilized by companies such as Raytheon, Bendix, General Dynamics, Magnavox, Martin Marietta, and Ford Motor Company.

Acoustic Wind Tunnel

The Acoustic Wind Tunnel is a large, quiet, low Mach number facility specifically designed to perform basic investigations in the areas of hydrodynamics and hydroacoustics on small-diameter underwater vehicles. It was designed to be a general-purpose research tool for advanced studies in propulsor hydrodynamics, hydroacoustics, in-flow analysis, boundary layer turbulence, and wake studies.

Construction techniques and design flexibility allow the tunnel to support a multitude of test configurations. The test volume is acoustically anechoic (100 Hz to 40 kHz) and completely isolated, resulting in the lowest ambient noise levels of any known equivalent facility. Operating speeds of up to 200 feet per second can be accommodated with the standard 4-foot-diameter circular test section. At 150 feet per second, the turbulence intensity and spatial uniformity of the flow is 0.3% and 99.5%, respectively.

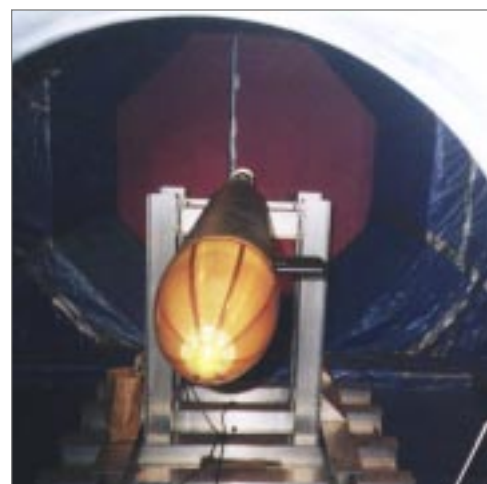


NUWC Division Newport's Acoustic Wind Tunnel has the lowest background noise compared to five of the best wind tunnels in the world



Vehicle testing in the Acoustic Wind Tunnel

The closed-loop facility incorporates air conditioning, allowing air at constant Reynolds number and humidity to flow across the test item. Design flexibility allows the acoustic test section to be converted from fully anechoic to a reverberant environment. The facility is supported by independent high/low rate and digital data acquisition systems. These systems allow multi-channel measurements of flow-induced phenomena, including acoustic radiation and directivity, turbulence, velocity, and pressure distributions; and of steady and fluctuating aerodynamic forces in a very quiet acoustic and flow background environment. Specialized vehicle mountings keep in-flow turbulence to the propulsor free from noise contamination. A removable sting anchored to the tunnel is used to mount vehicles up to 1,000 pounds in the wind tunnel. Large access doors, facility cranes that can support loads up to 5 tons, and a flexible testing arrangement make this facility well suited for dual-use projects such as automobile or environmental flow studies.



Testing of torpedo and submarine models in the Acoustic Wind Tunnel

Acoustic Test Facility

The Acoustic Test Facility is a collection of highly specialized equipment for acoustic evaluation of underwater sonars for vehicles and targets. Capabilities include the measurement, characterization, modeling, analysis, and reduction of complete underwater weapon systems or individual system components.

The facility's reverberant test tank is a 700,000-gallon vessel that measures 60 feet long, 40 feet wide and 35 feet deep. The tank is partially lined with a thin wedge design anechoic coating and is supported by a variety of handling and positioning equipment, including overhead 3-ton cranes, rotators, and movable test bridges. The test tank provides a maximum 50-foot test distance, with 2 ms of reflection-free test time. One-man operation is possible with minimal setup time, and two or more simultaneous test setups can be accommodated.

The facility's mechanical support equipment can handle test specimens weighing up to 5 tons and can rotate specimens in three dimensions to a computer-controlled accuracy of 0.001°. Underwater laser alignment of test devices is available when it is necessary to establish precise mechanical alignments independent of the acoustic main response axis. An X-Y-Z positioner is available with a capability of 6 feet of travel in each axis and an accuracy within ± 0.001 inch. An underwater rotator can be used with this positioner to provide roll or tilt rotations in synchrony with X-Y-Z positions. A graphite composite cylindrical pressure vessel serves as an acoustically transparent test vessel for performing acoustic tests at pressures up to 800 psi at temperatures from 35°F to 120°F. The pressure vessel opening is 32 inches in diameter and has an acoustic test window length of 60 inches around its circumference.

Scale model target strength setup in the Acoustic Tank



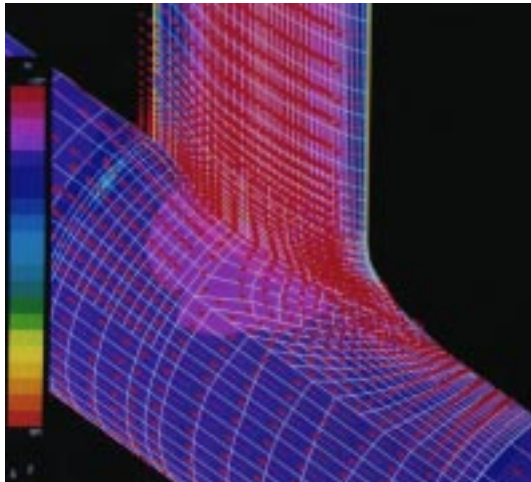
Measurement of plate vibrational modes using scanning laser vibrometer in the Acoustic Test Facility

Advanced Scientific and Engineering Computational Center

The Advanced Scientific and Engineering Computational Center (ASECC) is a Division resource that provides high-performance computing (HPC) for computation-intensive scientific and engineering applications. The ASECC houses a CRAY-T3D massively parallel processing (MPP) system, a high-performance workstation cluster and a mass-storage and archival system. In addition, the ASECC provides remote access support to numerous high-performance computers, including CRAY supercomputers and other maturing, scalable parallel systems.

The ASECC also provides software support to users of its computational resources, mass-storage system, and remote high-performance computers. The user support staff assists Division researchers with code porting and conversion; third-party COTS application software products; distributed applications between workstations, scalable parallel systems, and CRAY supercomputers; training seminars; and workstation-to-cluster-to-HPC compatibility solutions.

Simulation of vector forces around the sail of a submarine



NUWC Division Newport's CRAY-T3D supercomputer and its support staff



At the heart of the ASECC is a CRAY-T3D MPP system, which contains 64 individual processing elements each rated at a theoretical peak of 150 MFLOPS and each processing 64 MB of memory. The system as configured provides in excess of 10 GFLOPS of computing capability. This distributed memory is then made available to all users of the system through a high-speed distributed interconnect. A front-end system provides control of the attached rotating storage disk devices and high-speed access to the local area network.

Dual Uses & Technology Transfer

The focus on exploiting technologies with dual-use applications has really paid off for the Navy, especially at Division Newport. Through a cross-fertilization of ideas, scientists and engineers at the Division have utilized various programs to facilitate the transfer of technology between government organizations and industry.

Focusing on technologies that could have applications to both military and commercial areas, government organizations and their industrial partners are developing a common commercial and defense industrial base that is of critical importance to U.S. economic growth. Both parties gain from partnering, enhancing U.S. economic competitiveness and creating larger markets.



Capt. Stephen J. Logue inspecting the electric vehicle

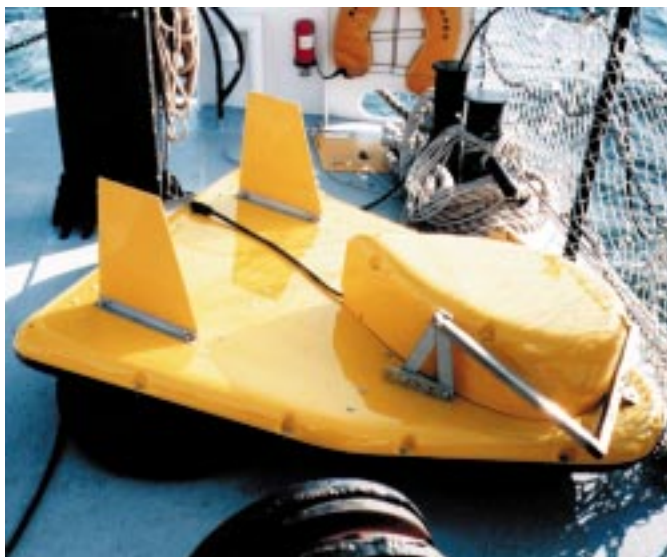
The NUWC-patented Elastomeric Torpedo Launcher System is an excellent example of developing technologies that are vital to the future of undersea warfare and that also have substantial commercial promise. The Elastomeric Torpedo Launcher System is as quiet as, and cheaper than, any other launcher and can be applied to small devices as well as to full-scale torpedo launchers. This system, which simplifies complex hydraulic circuits, is an excellent example of the payoffs of investment in research and high technology. One full-scale elastomer disk has recently completed launch demonstrations and

survived more than 2500 full inflation launches in the Division's Submerged Launch System Test Facility. A second elastomer disk has also completed more than 2800 cycles in the Full Scale Fatigue Test Facility. Not only is this system estimated to cost one-tenth as much as previous systems, but it may also be used commercially in water distribution and fluid processing applications.

In addition to teaming on research, the Division's unique facilities are made available to industrial and academic communities for either collaborative or independent research and development projects through the Technology Transfer Program. Agreements and contracts for accessing facilities and services are flexible and can be tailored to the requirements of the particular project. The Division is communicating with industry, informing them of the resources and licensable technology available, and encouraging broader technology transfer. As well as investing personnel, services, facilities, and equipment, the Division has derived significant direct funding from the use of unique facilities.



Through a cross-fertilization of ideas, scientists and engineers at the Division have utilized various programs to facilitate the transfer of technology between government organizations and industry.



Ocean Bottom Profiler

The Ocean Bottom Profiler is a project with Precision Signal Inc. of Boca Raton, FL, a small business specializing in surveying ocean floors with imaging equipment. The purpose is to develop state-of-the-art equipment to map deep- and shallow-water ocean floors and to study sub-bottom sediment structures. The Division's converted torpedo sonar hardware is being used, along with Precision Signal's equipment and special methodologies. The technology can be used for commercial mineral exploitation and communications, and for underwater detection of unexploded ordnance.



Coronary testing in the Anechoic Chamber

Another recent project is with a California small business working to develop a method and device for the non-invasive detection of coronary artery disease using nontraditional signal processing techniques. Successful completion of the processing of acoustic signals within the cardiac cycle project will help save lives through early detection, diagnosis, and treatment. The Division will gain low-cost implementation and evaluation of signal processing algorithms relative to its interests in tactical surveillance.

The Division has also collaborated with the Connecticut Municipal Electric Energy Cooperative (CMEEC) to establish electric vehicles as a viable means of alternate energy transportation. This project utilizes Division Newport expertise in sensor measurement technology and CMEEC's experience in electric vehicle development and operation. The improved operator console and sensor measurement system will increase the operating efficiency of electric vehicles and will provide measurements to test improvements in high-capacity batteries, low rolling resistance tires, and solar cells.

ES

LD

U

D



Perry Technologies' Mobile Undersea Systems Test UUV with two types of fiber optic tethers

Division Newport has also forged partnerships within the community. These include several Education Partnership Agreements (EPAs) that allow the Division to loan lab equipment or donate surplus equipment. EPAs also allow Division engineers and scientists to teach or

develop curriculum, include students in laboratory research projects, and allow students to receive academic credit for laboratory research projects and to work together as colleagues with participating faculty. An EPA with OceanQuest, a major economic development and diversification project for Southeastern Connecticut, includes an ocean science center, an oceanographic educational camp for children and young adults, and a hotel, restaurant, and meeting facility. It is the largest educational project in New England. An EPA with the University of Massachusetts Dartmouth Center for Marine Science and Technology covers engineering, mathematics, oceanography, marine science, and technology. Two recent agreements have been signed with Yale University and the University of Rhode Island. The Yale EPA covers engineering, fluid mechanics, acoustics, and applied mathematics. The URI EPA deals with ocean science, engineering, technology, and policy.

Division Newport is also a member of BERTEX, the Brown (University) Engineering Regional Technology Exchange. The goal of BERTEX is to help foster a more diversified industrial community in Rhode Island, one that includes substantial organization for engineering research, advanced design, and development for today's highly competitive marketplace, and also to create a thriving industrial complex in the region.

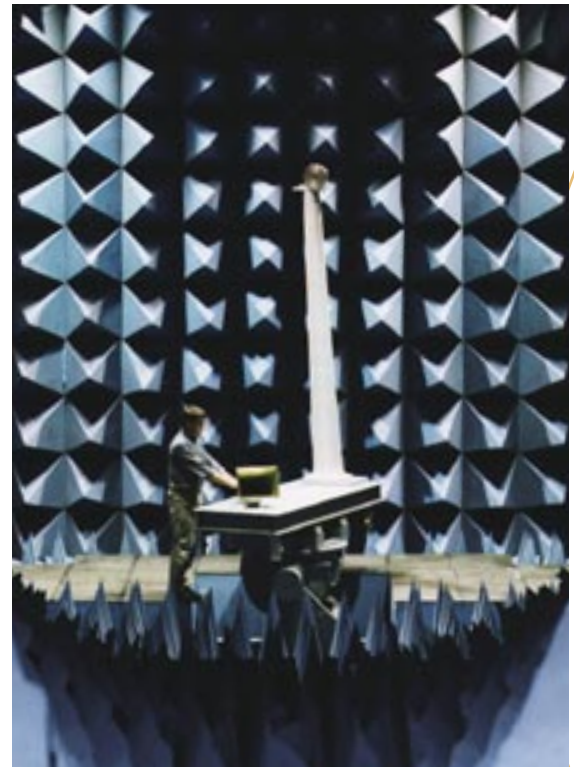


Bottom crawling vehicles, or "lemmings," are part of a CRADA with Foster-Miller, Inc. These expendable vehicles are used in parallel formation to perform surf zone surveillance operations.

Moving Forward

Planning the organized chaos of science and technology is a difficult task on any level. The Department of Defense recently released a plan that describes its basic research strategy and highlights the significant role that basic research will play — “it is the cornerstone of DoD science, engineering and technology programs.”

The strategy also recognizes the need to initiate and sustain both evolutionary and revolutionary components: the former to meet the needs of current warfighters; the latter, to fulfill future defense requirements, some of which admittedly remain ill-defined, and some of which do not exist at all today. This balanced approach, combined with aggressive qualitative and quantitative forecasting, has produced many of the “unplanned” successes we have enjoyed — successes that satisfy both immediate and long-term needs of the Navy and Marine Corps.



The cadre of scientists and engineers responsible for the Science and Technology base have been consolidated at the Division’s Newport, Rhode Island location. Over the past three years an investment of more than \$40 million has been made in new construction research and development laboratories and professional spaces at Newport to accommodate this consolidation.

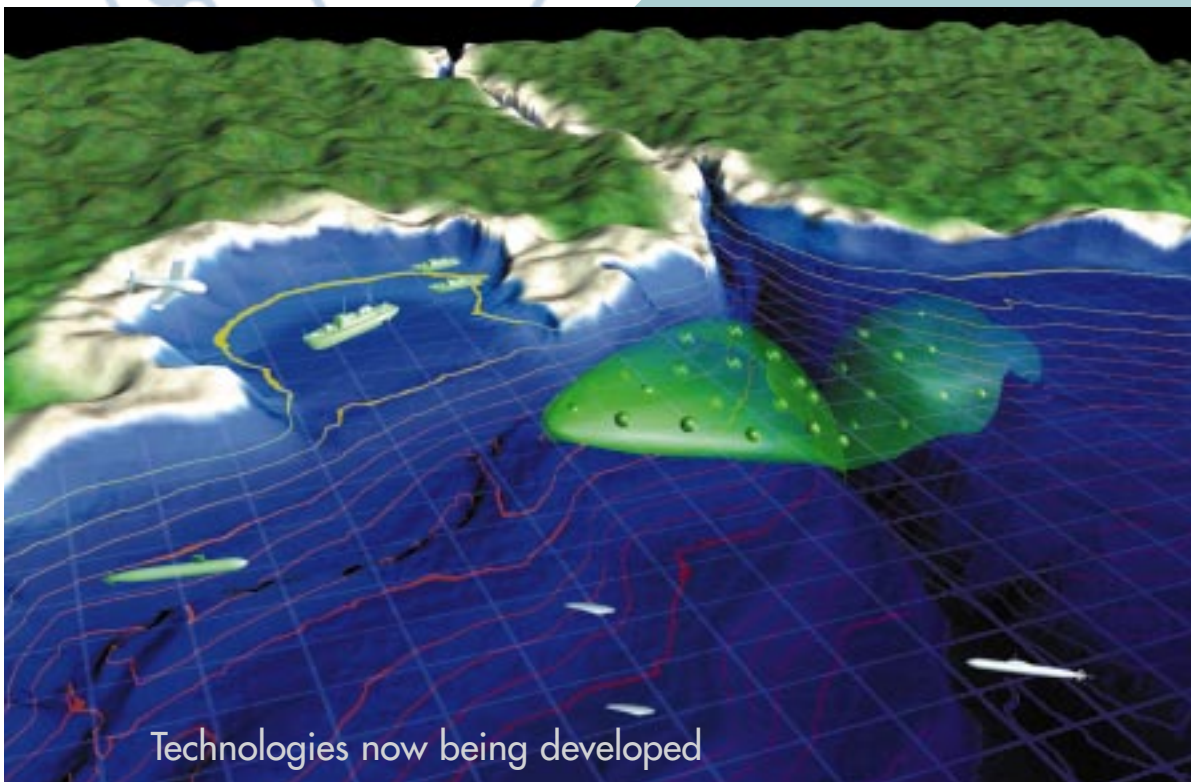


The future of science and technology for our Division depends largely on the expertise, skills, inventiveness, and dedication of the people described in the preceding pages. Collectively, they do not represent large numbers, but they do represent the core capabilities that have been maintained throughout the one hundred year plus history of our Newport and New London laboratories.



As the novelist Graham Greene once said, “There always comes a moment in time when the door opens and lets the future in.” In the present day, the end of the Cold War has opened such a door — our future is out there waiting.

Technologies now being developed at Division Newport will shape the future of undersea warfare. Shown here (opposite page) are the Tapered Anechoic Chamber and the Warfare System Presentation Facility and (this page) the "Manta" unmanned undersea vehicle which is the centerpiece of an expanded undersea battlespace concept.



Technologies now being developed

at Division Newport will shape the future of undersea warfare. Shown here (opposite page) are the Tapered Anechoic Chamber and the Warfare System Presentation Facility and (this page) the "Manta" unmanned undersea vehicle which is the centerpiece of an expanded undersea battlespace concept.



**For further information on
NUWC, Division Newport's
Science & Technology Program,
contact:**

Dr. Richard H. Nadolink
Director for Science & Technology
nadolink@npt.nuwc.navy.mil

Naval Undersea Warfare Center
Division Newport
Newport, Rhode Island
02841-1708

The Naval Undersea Warfare Center
is an equal opportunity employer.
U.S. citizenship required.

Approved for public release;
distribution is unlimited.