NOT FOR PUBLICATION UNTIL RELEASED BY THE
HOUSE ARMED SERVICES COMMITTEE
TERRORISM, UNCONVENTIONAL THREATS AND CAPABILITIES SUBCOMMITTEE

STATEMENT OF
REAR ADMIRAL WILLIAM LANDAY, UNITED STATES NAVY
CHIEF OF NAVAL RESEARCH

BEFORE THE
TERRORISM, UNCONVENTIONAL THREATS AND CAPABILITIES SUBCOMMITTEE
OF THE
HOUSE ARMED SERVICES COMMITTEE
ON
DEFENSE SCIENCE & TECHNOLOGY POLICY AND
THE FISCAL YEAR 2008 BUDGET REQUEST

MARCH 21, 2007

NOT FOR PUBLICATION UNTIL RELEASED BY THE
HOUSE ARMED SERVICES COMMITTEE
TERRORISM, UNCONVENTIONAL THREATS AND CAPABILITIES SUBCOMMITTEE

Introduction

It is an honor to appear before you today to update you on the progress of the Science and Technology (S&T) efforts within the Department of the Navy and to discuss how the President's Budget Request for FY 2008 supports the Navy and Marine Corps team.

The Naval S&T challenge is to enable revolutionary operational concepts that support the vision for the Navy and Marine Corps as laid out by the Secretary of the Navy, Chief of Naval Operations and Commandant of the Marine Corps. They envision a force that is expeditionary, distributed, persistent, forward deployed and capable of defeating a competitor in major combat operations or in various scenarios in the global war on terror.

We place particular emphasis on joint operations in blue, green, and brown water environments, as well as on any shore environment where U.S. Marines may be called to serve. Leveraging innovative concepts, advanced technologies, and new business practices to increase war fighting effectiveness, we will use enhanced, networked, joint Sea Basing to operate without restriction. The Office of Naval Research (ONR) S&T portfolio is a critical element of the Navy and Marine Corps' vision and strategy for the future.

S&T Overview

Our S&T enterprise must focus on developing not only tomorrow's Navy/Marine Corps but also the one after that – yet be nimble enough to rapidly address critical problems facing today's fleet and force. We must do three things exceptionally well: First, we must focus on areas that provide the biggest payoff to support the Navy/Marine Corps of the future. Second, we must be innovative in our thinking, our science, and our business processes – because every dollar spent on "overhead" is a dollar not spent on science and technology. Third, we must continually improve our ability to rapidly transition S&T into acquisition programs and into the Fleet.

The President's Fiscal Year 2008 Budget requests $1.667 billion for an S&T portfolio that accomplishes what I just described. This reflects a 2% growth in constant year dollars over the President's FY 2007 budget request.

S&T Strategic Plan

An updated Naval Science and Technology Strategic Plan was recently approved by Navy and Marine Corps leadership. It ensures alignment of Naval S&T with Naval missions and future capability needs. It will ensure that S&T has a long-term focus but is responsive to near-term needs. It will communicate our S&T vision and approach to decision makers, S&T partners, customers and performers.

The S&T Strategic plan identifies 13 key areas where S&T investment will have high payoff in supporting the Navy and Marine Corp vision and needs. Those focus areas are:

NAVAL S&T STRATEGY FOCUS AREAS

- Power & Energy
- Operational Environments
- Maritime Domain Awareness
- Asymmetric and Irregular Warfare (Combating Terrorism)
- Information, Analysis and Communication
- Power Projection
- Assured Access and Hold at Risk
- Distributed Operations
- Naval Warrior Performance and Protection
- Survivability and Self-Defense
- Platform Mobility
- Fleet/Force Sustainment
- Affordability, Maintainability, Reliability

In executing this plan, we must address 5 key tenets:

- We must have the ability to monitor, assess and leverage emerging science and technology in a global manner. The increasingly rapid movement of technology and innovation around the world, demands that we be able to take advantage of emerging ideas and science regardless of where they originate.

- In order to achieve that flexibility, we will focus the majority of our investments on external performers – those outside the naval R&D system in order to tap into the full spectrum of innovative thinking and discovery.

- While the majority of our investment will be external, we need to preserve and nurture the world class skills and innovation that exists in specific Naval focused areas within our lab system, especially at the Naval Research Lab.

- We must build an investment portfolio that is balanced between the long range scientific discovery that comes from the Basic Research program and the nearer term, focused, product nature of the 6.3 programs. We must focus on delivering value to today's Sailors and Marines, while ensuring the well of new and novel technology development remains deep in support of the next generation of Sailors and Marines.

- We must focus our efforts on eventual transition of technology and innovative concepts to the war fighters. We are not about S&T, but rather we are about S&T in support of our Sailors and Marines.

Executing the Strategy

We execute our Basic Research (6.1) thru Advanced Technology Development (6.3) funds as a continuum of S&T development, breaking them into four key areas – Discovery and Invention (D&I), Innovative Naval Prototypes (INP), Future Naval Capabilities (FNC) and Quick Reaction S&T.

Discovery & Invention

Discovery and Invention (D&I) is basic research and early Applied Research (6.2) work that focuses on areas in which we have unique naval needs or support capabilities that we consider essential to the naval mission. We believe that a strong investment in this area is necessary to ensure we can maintain our technical advantages in the Navy after next.

41% of our investment is in our D&I program. We allocate that money across the core research areas through a rigorous analytical process to weigh relevance, impact on the Navy/Marine Corps mission, and potential for innovative performance to select the best mix of research areas and projects. This forms the foundation of our S&T portfolio, developing a broad and deep base of scientific knowledge and innovation from which our FNC, INP and quick reaction efforts are formed.

One of ONR's D&I successes is the Multi-disciplinary University Research Initiatives (MURI) program to develop long lasting, high temperature resistant, Thermal Barrier Coatings (TBCs). TBCs are used to insulate metal components from very hot gases in aircraft and shipboard turbine engines. For many years, TBC durability was limited due to the lack of understanding of the fundamental materials properties of these coatings and their failure mechanisms at high temperatures. The MURI TBC program and follow-on Applied Research efforts resulted in accurate coating life prediction models, alternative materials with superior performance, and improved TBC deposition processes. Improved engine performance and cost savings as a result of the TBC program will be significant. Expected payoffs include higher turbine engine power density, reduced specific fuel consumption, longer range, reduced maintenance, and increased combat readiness. An industry transition pathway for these coatings and processes has already been established.

Another D&I success involves Human Behavior Modeling. The goal of this program is to develop instructional systems and models of human cognition and performance to support the design of advanced, simulation-based, Naval training systems. Accurate modeling of individual behavior currently poses only moderate technical challenge, but the computational modeling of groups, teams, crowds, and organizations is highly challenging and involves modeling communication/co-ordination, group cohesion, and cultural influences. This program seeks to develop realistically behaving synthetic crewmates and adversaries to provide challenging training for Navy and Marine Corps warfighters with an effectiveness and affordability far exceeding what is currently possible. One element of this program, the modeling of synthetic insurgent forces for Marine Corps urban warfare training, is expected to transition to the U. S. Marine Corps (USMC) Deployable Virtual Training Environment Program during FY 2007.

Still another D&I success involves Information Assurance and Security. Naval operations rely on assured, affordable, secure, and safe interoperable information and communication systems that can satisfy hard real-time, fault tolerant requirements and can repeatedly withstand sophisticated, malevolent attacks. The Information Assurance and Security Program enables the production of safe, secure, dependable software systems that meet Naval requirements and minimize cost by maximizing the use of Commercial Off The Shelf (COTS) and open source products that are not designed to meet Naval needs.

Research conducted under this program will explore the science of concealed knowledge in text, images, and speech to detect covert communication and to prevent leakage of information when, for example, Intelligence data is downgraded for dissemination across C2 networks for operational use. It will investigate techniques and develop tools to discover dependencies in complex distributed software and ensure that these systems satisfy critical safety, real-time/fault-tolerant properties. It will also develop algorithms, secure protocols, architectures, protection mechanisms and procedures, software tools, languages, and design and development methodologies to enable the development of affordable high assurance systems. Finally, it will develop certification technologies, standards, and guidelines that enable the secure, safe, and timely certification, accreditation, and deployment of technology by the Navy and DoD

Innovative Naval Prototypes

Our Innovative Naval Prototype (INP) program has begun to hit its stride in FY 07 and the FY 08 investment will keep them on track. Seven percent of our total budget request is focused on INPs. These INPs are disruptive technologies that have the potential to enable breakthrough or game changing capability. INPs invest in S&T projects intended to achieve levels of maturity suitable for transition to acquisition programs within 4-8 years. The budget request continues support of four such programs – Electromagnetic Rail Gun, Persistent Littoral Undersea Surveillance, Tactically Responsive Space and Sea Base enablers. I would like to highlight two of the successes in our INP program:

Electromagnetic Rail Gun – This program is moving ahead very aggressively and has already achieved a number of notable successes. In 2006 we opened our large scale test facility at the Naval Surface Warfare Center in Dahlgren Va. This facility enables us to conduct tiered testing of rail configurations and materials by leveraging the broad spectrum of small scale testing being conducted at various universities and DOD labs. The most promising advances move to large scale testing at the Dahlgren facility, which has one of the largest known rail guns of its type (8MJ muzzle energy). Additionally we have completed the design and began fabrication of a 32MJ laboratory launcher, which will be installed in late summer of 2007. This will allow us to conduct firings at power levels not available anywhere else in the world. Additional achievements include; progress in extending barrel life through use of lubricants, and a multi shot test using specialized materials.

Pre-engineering activities are competitively developed with industry to ensure a future industrial base for multiple configurations. Both BAE and General Atomics have completed concept trade studies for advanced rail gun barrels and are six months into a 30 month technology development

and preliminary design effort. Additionally, Draper Labs and Boeing completed projectile concept trade studies, which identified critical component options.

Although these projects will remain in S&T for 4-8 more years, we are working directly with the acquisition programs that will implement the technologies. In fact, to ensure seamless and efficient transition when the technology is ready, the deputy S&T project manager is a Naval Sea Systems Command (NAVSEA) acquisition program manager.

In addition, our efforts are closely tied to the Army rail gun program in order to leverage development, coordinate resources, and eliminate duplication. Army and Navy program managers meet monthly and attend each other's key meetings and reviews to identify future joint development opportunities. It is particularly notable that Army donated the launcher and capacitor bank that enabled Navy's initial 2006 test at Dahlgren

Persistent Littoral Undersea Surveillance (PLUS) – This program is developing a revolutionary approach to Anti-Submarine Warfare using autonomous, mobile, controllable networks of undersea sensors and vehicles to provide surveillance of large areas over long periods of time. The system will be capable of adapting to its environment, persisting clandestinely for months, and self-deploying from long range. PLUS reverses the current asymmetry of using high-value capital warships in one-on-one engagements against quiet diesel submarines. Instead, it uses large numbers of relatively inexpensive unmanned vehicles and sensors to find, track, and if necessary engage threat submarines.

PLUS builds on a legacy of component technologies developed in ONR's D&I program. Component technologies include: 1) inexpensive unmanned mobile platforms adapted from glider technology developed for oceanographic research that can travel over long ranges and persist in the environment for months, 2) systems using a variety of sensing mechanisms with significant detection range in compact packages capable of being carried by a small undersea vehicle, and 3) the ability to communicate underwater using acoustics, at significant data rates over meaningful distances. Significant technical challenges remain. We need a system that is highly autonomous, with high probabilities of detection, and low false alarm rates. Integration of component technologies is a major challenge. Although we can do a lot in the lab, there is no substitute for taking technology to sea to find out if it really works. For PLUS, we've already started the process, through a major experiment in Monterey Bay last summer and another experiment planned in the San Diego area at the end of FY 07.

Future Naval Capabilities (FNCs)

One of our highest priorities continues to be improving the transition of deployable S&T products, more rapidly and with less risk to the acquisition program managers or directly to the end users. We are building regular, early partnerships between scientists and acquisition program managers in an effort to improve that transition. It is critical that the acquisition managers understand what capabilities and technologies are on the way from the S&T portfolio and that they have already determined how they can best fit into their program of record, well before they arrive. It is equally important for S&T managers to understand factors driving acquisition managers, and be particularly sensitive to when the acquisition manager is best able

to handle new technologies and when the window for inclusion of new ideas is closing. In the past, that relationship was often established too late in either process for us to be as effective as we could be.

While not the only means for S&T to transition to the Fleet, our Future Naval Capability (FNC) program is the most critical component of our transition strategy. FNC Program investments were restructured in early 2005 to better align this "requirements-driven, transition-oriented" portion of the S&T investment portfolio to Naval Capability Gaps identified by OPNAV and Marine Corps Combat Development Command (MCCDC) through its Naval Capabilities Development Process.

As opposed to high-risk/high-payoff INP projects, FNCs involve more near-term projects. Approximately 30% of our S&T investment in the 2008 budget request is invested in the FNC Program. The FNC process delivers maturing technologies to acquisition program managers for timely incorporation into platform, weapon, sensors, and process improvements efforts.

FNCs are projects that are based on earlier investments in the D&I portfolio, where the technology has matured to the point that they can achieve a Technology Readiness Level (TRL) of 6 or better within the next 3-5 years. The FNC projects selected address specific capability gap needs, selected annually through an established process with final prioritization approved by a 3-Star Technology Oversight Group (TOG) representing OPNAV/USMC, Commander Fleet Forces Command (CFFC), Assistant Secretary of the Navy for Research, Development and Acquisition (ASN-RDA) and ONR. The Enabling Capabilities (ECs) selected represent the highest Navy/Marine Corps priorities.

Once approved, all technology products are required to have Technology Transition Agreements that document the commitment of the resource sponsor, acquisition program office, and ONR to develop, deliver and integrate those products into new or upgraded systems that can be delivered to the Fleet/Force.

Each year, every FNC product's progress and transition status is reviewed. Products that no longer have viable transition paths are terminated and residual funding is used to solve unexpected technology development problems within existing ECs, or start new ECs, in strict compliance with established DoN priorities.

There are currently 141 FNC projects underway in various stages of their 3-5 year development. 49 are expected to complete and transition in 2007. The FY2008 budget request continues funding for the remaining projects and initiates an additional 25. The FY07 transitions include technology in human strength amplifying technologies, corrosion control techniques to reduce operations and maintenance, technologies to protect surface ships from torpedo salvos, and in-stride/stand-off technologies to breach mines and obstacles in surf and beach zones.

We plan to complete and transition an additional 24 projects in FY 08. They include algorithms and computer programs for integrating real-time sensor data and non-real time data to reduce target track and identification conflicts; integrating object recognition and tracking algorithms, machine vision, multiple network video streams, geospatial data and operational context to flag

atypical activity and recognize known threats; and a robust active Rocket Propelled Grenade (RPG) defense capability to detect and initiate countermeasures and subsequently defeat RPG warheads.

The critical measure of success of this program is whether the technology met its technology requirements and exit criteria, and whether the acquisition program manager has transition funding within his or her program plan to accept and integrate the FNC product into their programs. As you can see from the table below, we have had good success in this effort and continued to improve our transition rate from 2005 to 2006. We expect equally strong performance in 2007 and 2008.

FNC Transition Summary	FY05		FY06	
	# Products	% Plan	# Products	% Plan
Products Planned to Complete	30		27	
S&T Completed or Near Complete with Manageable Risk	28	93%	26	96%
S&T Completed or Near Complete and Transition Funds Programmed	20	67%	25	93%
S&T Completed or Near Complete and Transition Funds Planned	4	13%	0	0%
S&T Completed and No Transition Funding	4	13%	1	4%

Increases and Decreases in FNC Funding Levels

When the FNC Program was restructured in 2005, funding was realigned within ONR's Applied Research (6.2) and Advanced Technology Development (6.3) Program Element (PE) lines so that all technologies associated with each Enabling Technology were funded as a unit. This eliminated situations where component technologies were pulled from multiple PEs, making it extremely difficult to track investments. FNC investments are now aligned to the most appropriate 6.2/6.3 PE lines. This change will enhance visibility of these investments.

Because these investments are not level funded, but rather focused on the most pressing capability gaps identified each year, they generate movement in funding levels for the associated PEs from year to year. Since FNC investments mature and develop technology products over a 3-5 year period, the Technology Readiness Level (TRL) of the underlying products moves from 6.2 PEs to 6.3 PEs. Typically, but not always, the first year of an EC is predominantly 6.2; the final year is predominantly 6.3 – with a mix of 6.2/6.3 in-between. Furthermore, in any given year, as products are delivered and transition to Advanced Component Development and Prototypes (6.4) funding, the new FNC projects that are beginning are frequently not in the same PEs as those that just completed. These changes can appear to be PE program growth, when the changes actually reflect realignment of funds in response to successful technology transition – coupled with reprioritization based on evolving Naval needs and requirements.

Current S&T Program Highlights

Within the broad structure of the naval S&T portfolio, there are a wide range of S&T projects either entering the fleet or poised to do so within a short time. I have included some examples of

those efforts with respect to the direct impact they will have on Sailors and Marines, both today and in the future.

Counter-proliferation

Mr. Chairman, before turning to the portion of my testimony describing ONR's contribution to the Navy's overall S&T program, I know that you and other members of the subcommittee are interested in counter-proliferation, particularly with respect to how all of us are working to solve some of these problems. For ONR and NRL, the principal focus of our efforts is combating weapons of mass destruction (WMD). The Navy's contributions to these efforts are detailed in the 2007 CPRC Report to Congress. Specific ONR contributions include development of an Agent-Based Modeling Disease Spread Planning Tool for General Medical Officers that accurately depicts human behavior and assesses the impact of communicable disease spread in civilian and military populations with specific bioterrorist agent modeling applications. We also have a Multi-Disciplinary University Research Initiative (MURI) Project involving Novel Therapies for Pneumonic Plague Targeting Quorum Sensing Components and Novel Antibiotics to develop antibiotics and vaccines that have the potential to avoid or defeat development of drug resistance by targeted pathogens.

ONR has also increased our emphasis in areas such as Weapons of Mass Destruction (WMD) detection to develop tools for use by Navy boarding teams and Large Vessel Stopping. The Navy WMD detection program will develop technology to protect the U.S., our forces and allies from smuggled nuclear weapons and WMD materials in the maritime environment. Free electron laser technology will play an important role in this effort. Our research benefits from a continuing partnership with the Defense Threat Reduction Agency (DTRA), which assigned a member of the Senior Executive Service (SES) to work at ONR on specific Naval applications. Similarly, terrorist use of ships with hazardous cargoes is a hazard scenario in the homeland security preparedness standards developed by the Homeland Security Council. The Large Vessel Stopping program will develop non-lethal technologies to provide the Navy with the capability to stop and/or restrain uncooperative large marine vessels to support search, interdiction, and counter-terrorism operations. As referenced elsewhere in this testimony, ONR and NRL are teamed to provide innovative technology to provide solutions for counter-proliferation and counter-terrorism wherever required – and to keep our hands on the pulse of foreign scientists with whom we engage around the world.

Manpower, Personnel, Training and Education (MPT&E)

For FY 08, ONR's Capable Manpower Program is focused on development of innovative technology-based products to enable transformation in Navy/Marine Corps Human Capital programs. These include manpower/personnel, training, and human systems integration products that enable ships, air, and warfare systems program managers to optimize system performance, minimize ownership costs, and ensure systems are built to accommodate characteristics of the Sailors and Marines that will operate, maintain, and support warfighting systems. New approaches to selection, classification, distribution, assignment, training, performance support, and system design are necessary to ensure that future combatants and related sea-service components are properly staffed for optimal readiness.

ONR is partnering with the Army to develop an Integrated Whole Person Assessment which would integrate a set of five tools for whole person assessment, to significantly reduce early attrition from service careers, while providing a monitoring and forecasting system for factors that influence career intentions and decisions.

We are developing incentive-compatible resource allocation tools to analyze tradeoffs between readiness, cost, and risk – and to provide flexible, capabilities-based planning tools in support of the total force.

We are working to improve human performance in Network-Centric Operations by developing and integrating critical anti-submarine warfare (ASW) training, mission rehearsal, and execution-support tools. Components of this research include providing force-level ASW training, knowledge management and distributed workflow systems, as well as collaborative tools to improve decision support and situational awareness.

We are developing Immersive Technology for Training to demonstrate and evaluate the integration of core technologies that support low cost, deployable individual and team training in simulated environments that are realistic as possible and focus on critical, high risk, costly tasks. We are also developing training to provide game-based learning environments for critical tasks, as well as systematically evaluate learning and performance results.

We are working to improve training for Expeditionary Warfare by developing and evaluating company/battalion-level command and control (C2) performance support systems, automated performance assessment, real-time/model-based performance diagnosis and training strategies. This will support multi-tasking in team environments, provide system assistance based on dynamic monitoring of user-state and system-state, and increase skill proficiency and retention.

Marine Mammals and the Environment

A significant effort is dedicated to effective and responsible stewardship of the marine environment, and this specifically includes the impact of national security requirements and activities on fish and marine mammals. Our goal is to mitigate any impact of the Naval presence on the marine environment, and marine animals and fish while maintaining the ability to train and operate as required to support the naval mission. Navy is a leader in marine-mammal research, spending approximately $10 million annually on research to understand how marine mammals may be affected by sound. This investment represents a majority of the dollars spent on this research in the U.S., and nearly half spent worldwide.

The Navy collaborates with universities, institutes, industry, conservation agencies, and independent researchers around the world to understand what combinations of ocean conditions, geography, and sonar usage patterns could potentially impact marine mammals and the environment. Congress has been generous in support of these programs and I look forward to continued partnership in achieving the goal of better protecting the marine environment.

Marines in the Urban Environment

Through Navy's SBIR program, ONR supported development of anti-terrorism/force protection decision support software by 21st Century System, Inc. The Hi-Resolution Situational Awareness (HiRSA) system provides wireless distributed asymmetric threat detection, reporting, and situational awareness. This product is a commercial-off-the-shelf, open-architecture, modular software package that can be used as a stand-alone system or integrated with existing systems. It provides an efficient, cost effective means to improve security, with significantly fewer sentries and support manpower. HiRSA is being used by the Marines at Camp Fallujah for perimeter security operations command and control and sensor management.

Marines on patrol may find themselves in situations where they need to "see around the corner." To meet that requirement, ONR developed Dragon Runner, a tactical unmanned ground vehicle employing advanced robotic technologies. Invertible, tossable, and remotely operated, Dragon Runner gives small units the ability to "see around the corner" with real time imagery, and is capable of carrying an array of sensor packages and lethal payloads. Developed in conjunction with the Marine Corps Warfighting Lab, Dragon Runner transitioned to the Joint Robotics Programs Office for further development and fielding.

Marines in urban environments are highly susceptible to short-range electro-optically guided munitions. In 2006, ONR field-tested a Multi-function Electro Optical System (MEOS) that will automatically detect multiple optical systems, including a direct view optical sight from anti-tank guided munitions at 250 meters.

An ONR 07 FNC delivered a prototype system providing automatic detection, location, identification and engagement of hostile fire sources in constrained, dispersed and urban environments, in near real-time, with a high degree of precision. The effort will provide fire detection and counter-fire capability that will be transitioned to robotic applications.

Improvised Explosive Devices (IEDs)

Working closely with the Joint IED Defeat Organization (JIEDDO), ONR funds a variety of IED prediction efforts involving dynamics of terrorist movements, analysis of human activity associated with placement, uncovering support networks, tracking factory locations and events, bio-forensic profiling for tracing place of origin, and dynamic analysis of suicide bombing. We are committed to research complementary to other DoD and U.S. efforts and foster collaboration with allies in the war on terror.

In addition, Counter-IED projects sponsored by ONR include development of non-contact sensor systems to detect a broader range of explosives. ONR is also working on computational heuristics, validation methods and dynamic cultural preparation of the battle space to improve prediction methods. These projects anticipate future threats, as well as put us in a better position to respond as conditions change.

Near-term IED program initiatives include the Marine Corps Advanced Technology Development efforts to neutralize IEDs through improved countermeasures. Warfighter

Protection Advanced Technology Development efforts include modeling the human torso in a thermobaric blast environment, modeling physical and cognitive effects of blast exposure and conditions arising from traumatic brain injury.

Mid-term IED program efforts include Force Protection Applied Research to develop improved warfighter extremity protection, explosive sensors using engineered proteins, and multifunction toxin decontamination coatings. Common Picture Applied Research is working to provide mobility in adaptive sensor networks, an automated face recognition system, and dynamic network analysis for terrorist networks.

Through Navy's SBIR program, ONR partnered with the "DoubleShot" company to develop the In-Vehicle Geo-Referenced Video Imaging System to acquire and retrieve GPS based video to enable a user to detect roadside hazards. It allows mission training and planning, route reconnaissance, intelligence gathering, and IED threat detection. In addition, DoubleShot's system demonstrated the capability to provide full integration of gunshot detection with a remote weapon station to enable counter-sniper capability for Stryker, HMMWV and LAV. Positive evaluations from Marines in Iraq led to issuance of an Urgent Universal Need Statement, and over 100 systems have been ordered.

Support for Naval Expeditionary Combat Command

The Naval Expeditionary Combat Command (NECC) was established in January 2006. Beginning in March 2006, ONR initiated meetings to determine what assistance we could provide to address NECC's near term S&T requirements. NECC's "Top 5" S&T requirements were for development of 1) a Small Backpack Vertical Take-Off and Landing (VTOL) Unmanned Ariel Vehicle (UAV), 2) a Larger Fixed Wing UAV (Tier II), 3) an Unmanned Surface Vehicle (USV) with a Mounted Gunslinger System, 4) a Vehicle Mounted Gunslinger System, and 5) a Ground/Air Target Sensor. Based on these requirements, the Navy Expeditionary Over-watch (NEO) Program, funded by ONR Swampworks, was created in order to develop a USV with Gunslinger Sensors and Gun Mount, a UAV with Sensors and Control/Display Systems and C2/Data Relay, and a Truck Mounted Gunslinger III System with Counter-fire Capability.

The NEO Spiral 1 program was initiated in August 2006, with an industry contract awarded in January 2007. As a result, Gunslinger Feasibility Studies are in-progress, while Weapon Placement and Configuration Analysis, Preliminary Safety Hazard Analysis, Sensor and Weapon Performance Analysis, and Evaluation of Non-Lethal Weapons, Self Protection Methods, and Other Sensors have all been completed. As part of the Spiral 1 effort, ONR will coordinate to provide training, operational test and evaluation, demonstration, and deployment into theater of all NEO systems. For FY 08, an NEO Spiral 2 program is being evaluated in order to provide NECC with additional operational capabilities, including: 1) expanded UAV capability for airborne ISR, 2) expanded multi-spectral sensor SA capability, 3) Force Protection FP Ashore to include IED detection, perimeter security, etc., and 4) USV counter-fire capability.

In a parallel effort, ONR conducted an NECC S&T Capability Gap Development Workshop in August 2006. The Workshop was designed to identify required S&T capabilities within NECC's

Expeditionary Echelon operational concept for Joint Task Force (JTF) commander support, capability gaps and S&T solutions to mitigate operational risk to NECC subordinate forces, enabling capabilities, and other areas of concern which could potentially be addressed by ONR. The Workshop report was published in October 2006, with a second Workshop scheduled for April 2007 with the purpose of refining the results from the first Workshop and publishing a Navy Expeditionary Combat Enterprise S&T Strategic Plan.

Vertical Lift

ONR has teamed with industry (Boeing & Bell) to develop a Reconfigurable Rotor Blade that when applied to tilt-rotor aircraft (like V-22 Osprey) has potential to significantly improve efficiency by changing blade twist in-flight, increasing aircraft performance over a conventional blade.

Relatively simple to retrofit or forward fit, this technology employs a lightweight, solid-state, electronic actuator within the rotor blade, providing an affordable, reliable means to significantly increase payload and mission radius and reduce fuel consumption. This is the first application of this technology in such a high gravitation environment as the rotor blade. Implementation reduces vertical flight penalties normally associated with design compromise in rotors or prop rotors, enabling new mission profiles for rotorcraft and tilt-rotorcraft.

This year sees an increased commitment to basic research in vertical lift technology. Our long-term vision for Vertical Take Off and Landing (VTOL) aircraft combines improved Naval mission effectiveness, increased affordability, maintainability, reliability, and unprecedented levels of safety and survivability for aircrews. To achieve these breakthroughs we have partnered with universities and Navy labs, and are leveraging Army, Air Force, and NASA research investments in vertical lift technology.

Power Projection and Time Critical Strike

Revolutionary Approach To Time Critical Long Range Strike (RATTLRS) is a model of Navy, Air Force, NASA, and OSD interagency cooperation: RATTLRS is a high speed non-afterburning turbine, Mach 3 flight demonstration program for a future expendable hypersonic weapon system with access to space options. Lockheed Martin Aeronautics, Advanced Development Programs, is the prime contractor and Rolls Royce – Liberty Works is developing the unique engine. RATTLRS has achieved or exceeded technical and program milestones on or ahead of schedule. Lockheed Martin is projected to achieve first flight 9 months ahead of schedule. This will be the first non-afterburner high-Mach turbine accelerator flight demonstration. Following the flight test, RATTLRS will be ready for SDD.

While still under development, RATTLRS has generated interest, support and transition to advanced applications. For example, the Air Force Research Laboratory (AFRL) and DARPA, have transitioned the RATTLRS core engine to further development in the joint HiSTED (High-Speed Turbine Engine Demonstration) program and will ground test the engine at Mach 4 and above in 2007.

Additionally, the DARPA/USAF FALCON (Force Application and Launch from CONUS) Program is developing a two-stage (turbojet/scramjet) propulsion vehicle that can be scaled up for the next generation long-range bomber. The FALCON Program plans to use RATTLRS core engine for its turbine accelerator, as well as RATTLRS airframe fuselage and control surface manufacturing techniques.

Fighting at the Speed of Light

We see significant progress in directed energy programs. Research in developing a Free Electron Laser (FEL) System shows promise as an effective, affordable point defense capability against surface and air threats, anti-ship cruise missiles, swarms of small boats, and other asymmetric threats. With ONR-Joint Technology Office sponsorship, a significant milestone on the path toward weapons grade FEL was recently achieved with the highest FEL output power ever, 14kW, at Department of Energy's Jefferson Laboratory.

In addition, ONR and Naval Aviation are supporting development of High Energy Laser (HEL) technology such as Solid State Fiber Lasers and Beam Control concepts for tactical airborne HEL missions. Fiber Lasers improve efficiency while reducing weight and volume, characteristics critical for tactical platforms. Fiber laser technologies are also being developed by ONR and NRL for ship based asymmetric threat engagement.

Affordable Ships

ONR efforts such as the Navy Manufacturing Technology (ManTech) program contribute to affordable acquisition programs throughout the Navy. ManTech has a history of working with acquisition programs and industry to address weapon production issues. In 2006 ManTech efforts were shifted to initiatives in affordability of four platforms: DDG 1000, CVN 21, Littoral Combat Ship, and VIRGINIA Class Submarine.

To identify opportunities for cost reduction, ManTech is focusing on Ship Construction areas involving schedule compression, production engineering, distortion, outfitting, neat erection, and materials and process improvements. In Electronics, ManTech is focusing on radar and communications, sonar and navigation, integrated power and propulsion. ManTech is also making recommendations to industry and acquisition programs with respect to potential cost reduction approaches in overall business operations.

Protection from Enemy Submarines

Antisubmarine warfare in coastal waters is a difficult challenge. ONR research efforts focus on enhancing our ability to detect, track, classify, and engage enemy submarines by using a layered tactical approach. Our objective is to understand, predict and manipulate the environment faster than our enemy.

Ocean sensing is a critical component of littoral warfare and the focus of our Littoral ASW Multistatic Project (LAMP) for submarine detection in shallow to deep water. It includes development of Compact Deployable Multistatic Sources and Receivers, Coherent Waveform

Processing, and Over the Horizon Communications. It will reduce flight hours for patrol aircraft, enhance reliability with field-level performance equivalent to Improved Extended Echo Ranging systems, and supports the requirement for a rapidly deployable distributed system for a transiting Battle Group.

In addition, we conducted initial deployment of the Network Centric Interactive Multi-Sensor Analysis Training (IMAT) ASW Training and Performance Support System – providing integrated training, planning, operations, and feedback for multi-platform ASW. This is a component of the ASW portion of Composable FORCENet systems currently in use at 7th Fleet, CTF-74 Theater ASW Operations Center, aboard USS Ronald Reagan, CVN-76, and other Carrier Support Groups and Expeditionary Support Groups.

Electric Power

ONR is investing in advanced technologies for high efficiency electrical systems and equipment to meet the increasing electric power requirements for advanced weapons, launchers and defense systems aboard ships and submarines. ONR programs focus on technologies and system architectures to increase power and energy densities and energy efficiency, with the goal of reducing the impact of high-power electrical power systems on ships. These efforts directly support the Naval Sea Systems Command and Program Executive offices for Ships, Submarines and Aircraft Carriers.

ONR partnered with industry to develop the High Temperature Superconducting AC Synchronous Motor, a high power density, lightweight advanced 36.5 MW propulsion motor and drive system suitable for possible Naval application. The potential payoff is reduced weight and volume for a ship electric propulsion system, increased survivability, and fuel savings. The prototype is expected to complete factory acceptance tests in FY07.

In coordination with the OSD focus on energy security, we initiated a Naval Future Fuels effort to investigate the impact of new fuel formulations on Naval machinery.

Radar Development

Another example of how ONR investments anticipate future Naval requirements is illustrated by advances ONR developed in high power solid state amplifiers for Naval radars in anticipation of the increasing capability required to deal with missile threats.

Beginning in the 1960s, research to demonstrate viable solid state GaAs transistors culminated in current GaAs technology used by all high performance radars – such as MFR, VSR, and JSF radars. This enables order of magnitude improvement in reducing clutter, as well as significant improvement in maintainability. These technical advances resulted in unanticipated breakthroughs that provided the genesis of today's cellular telephone industry.

Realizing that threat detection continues to grow in difficulty requiring even more powerful radars in the same footprint, ONR initiated research in next generation high power amplifiers, including growth of wide band gap semiconductor SiC. This material provides thousand fold

improvements in clutter rejection, and the research produced the baseline technology for the UHF E2D radar, as well as an option for the CGX S-Band ballistic missile defense radar.

Finally, appreciating the limitation of SiC technology, and realizing the need to go to higher frequencies, ONR initiated research in GaN wide-band gap amplifiers. This research is beginning to show the progress necessary for it to be considered for future high frequency radars and EW systems. It also led to a new form of lighting which is six times more efficient than incandescent lights – and lasts fifty times longer.

A related issue is the number of topside apertures on Navy ships increased significantly in the past decade. As the number of apertures increased, the need to reduce signatures, enhance performance of critical Electronic Warfare (EW) and communication functions, and resolve EMI issues has also increased. With the goal of reducing Radar Cross Section, deckhouse size, weight, and cost, ONR has programs to develop innovative apertures that combine functions while improving overall performance.

The architecture of these systems is based on a modular open systems architecture approach to allow for implementation of ship system designs at less cost; scalability across multiple platforms; facilitate rapid, affordable upgrades to meet future threats, and enable the commander to tailor optimal use of all RF power available to meet the demands of any battlespace environment. Several of these programs are transitioning now or are slated to transition to DDG-1000. ONR is leveraging these efforts into an overall program, the Integrated Topside Naval Prototype, to provide a systems level engineering approach to developing integrated topside that is optimized, open, and scalable to meet future requirements.

Understanding the Sea

Highly capable research vessels are critical to the success of our basic and applied programs in ocean sciences. Since 1972, ONR has partnered with the National Science Foundation and other agencies in the University National Oceanographic Laboratory System (UNOLS) to allow joint scheduling and operations of a fleet of research ships used by the academic oceanographers. Navy is proud to have supported the academic oceanographic community's ability to go to sea for the past 60 years.

The FY2008 Budget request continues the refinement of initial operational and science mission requirements for the next generation of Ocean Class vessels in conjunction with UNOLS. This year's efforts will include development of documents needed for a successful project Milestone A decision.

Workforce Development and Human Capital Strategy

Developing and refreshing our S&T workforce is a key emphasis this year as it has been in the past. While each of the Naval Research Enterprise (NRE) centers and labs recruit and maintain their workforce through a variety of locally managed programs, ONR assists them relative to the S&T subcomponent of the NRE's larger Science & Engineering population pool. For example, the Naval Research Enterprise Intern Program (NREIP) is open to students enrolled at one of 69

NROTC colleges, universities, or affiliates. This program offers full-time summer appointments at sponsoring Navy Labs, including the Naval Research Laboratory (NRL).

There are a number of Defense Scholarship Programs the NRE community uses to attract students to the defense industry. The National Defense Science and Engineering Graduate (NDSEG) Fellowship/Scholarship Program is an example of a traditional program. A newer tool is the Science, Mathematics, and Research for Transformation (SMART) Defense Education Program authorized by congress in FY 06. This education and scholarship program allows the NRE to recruit new talent as well as provides an opportunity for current employees to pursue advanced degrees in highly specialized critical skill shortfall areas. One measure of interest in the program is number of applications submitted: FY 07 saw over five times more applications than the number submitted in FY 06.

Collaboration between Navy and the National Science Foundation (NSF) continues. Navy and NSF are partners in a program to fund collaboration between academic researchers and Navy scientists working on difficult problems of naval interest. This program, the NSF-Navy Civilian Service (NNCS) program, is a "service payback" scholarship awarded to a small number of researchers who agree to work for the Navy at one of the NRE Laboratories and Centers.

Each Naval Research Enterprise Center conducts a variety of community outreach programs. For example, last year the Navy supported a pilot program to stimulate interest in science and engineering among middle-school children in Virginia. The Virginia Demonstration Project achieved participation from 1600 students in middle schools from three participating counties. The program culminated in a June 2006 summer camp that included 300 students, 24 teachers, and 12 Navy civilian scientists and engineers.

Conclusion

I want to thank you again for the opportunity to discuss initiatives undertaken by Naval S&T and your Navy/Marine Corps team and your strong support of our effort in the past. The FY 2008 President's Budget request is about both prevailing in today's wartime environment and bridging to a successful future. Building that bridge requires careful S&T investments that will protect this nation and our war fighters long into the future.

We have a near term focus on Iraq and a long term focus on strengthening the Navy's ability to meet any challenge and to adapt to any security environment. We are moving away from stove-piped roles and responsibilities and toward greater integration of capabilities, more effective partnership between the research and acquisition worlds, and a broader vision of how to achieve shared goals with DARPA and the Army and Air Force research organizations. This is evidenced by new directions in the Navy S&T Strategic Plan, by real increases in the President's FY 2008 S&T budget, and by the fact that approximately 10% of our research portfolio involves ONR partnerships with these and other organizations. In short, we are getting better by being smarter.

I believe the state of our S&T investments is sound, represents careful stewardship of taxpayer dollars, and will make significant contributions to our war fighters as they serve in defense of the United States, both today and well into the future. Thank you again for your support.