

NOT FOR PUBLICATION UNTIL RELEASED BY THE
SENATE ARMED SERVICES COMMITTEE
EMERGING THREATS AND CAPABILITIES
SUBCOMMITTEE

STATEMENT OF
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BEFORE THE
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Mr. Chairman, distinguished members of the Subcommittee, thank you for this opportunity to appear before you to discuss the Department of the Navy's fiscal year (FY) 2005 naval science and technology (S&T) budget request.

The last year has demonstrated how new technology and new operations have transformed the nature of the battlefield and the speed of operations. I want to highlight some of the contributions from the naval science and technology portfolio that have delivered new capabilities to our Fleet and Force. These are examples of how the Congress' sustained and stable investment in science and technology in the past delivers the technological superiority for our Sailors and Marines today.

Let me tell you about some of the science and technology success stories from Operation Iraqi Freedom. You will remember that I came before this subcommittee a few years ago and brought a prototype for demonstration of the Dragon Eye, a small unmanned aerial vehicle (UAV), for small unit tactical reconnaissance. The Dragon Eye is small, light, easy to transport, and easy to fly. This UAV has transitioned into the Marine Corps Force and will accompany the First Marine Expeditionary Force (I MEF) when it deploys to Iraq later this year.

We have long supported the development of unmanned underwater vehicles. The Remote Environmental Monitoring Unit or REMUS is a low-cost autonomous underwater vehicle. Originally designed to conduct coastal surveys in support of science, it was adapted for military use with support from the Office of Naval Research and the U.S. Special Operations Command. Capable of performing rapid environmental surveys, REMUS also functions as an underwater mine reconnaissance device for the Navy's Mine Countermeasure program. A half dozen of the REMUS autonomous underwater vehicles went with the Navy Special Clearance team to the Arabian Gulf to help clear the ports of Umm Qasr and Az Zubayr. Equipped with side scan sonar, REMUS was used to systematically survey 2.5 million square meters of waterways. This was the first time that an unmanned underwater vehicle was used in conjunction with other mine countermeasure units in a wartime situation. The team had the first REMUS in the water within several hours of arriving in Umm Qasr.

Another UAV used in Operation Iraqi Freedom is the Silver Fox. Built as a small tactical UAV, Silver Fox uses off-the-shelf avionics and can fly autonomously using differential Global

Positioning System (GPS). Weighing only 22 pounds, it can be launched by hand or catapult from various platforms. Once airborne, Silver Fox uses an infra-red and high-resolution color zoom camera to relay reconnaissance information instantaneously to a remote laptop computer. Powered by a 0.91 cubic inch engine, this fixed-winged aircraft can reach speeds close to 65 miles per hour and operate at an altitude of 1,000 feet with a range of up to 150 miles. We are working to increase the flight endurance beyond the current 10 hours. We are using the 4 pound payload capacity for small state-of-the-art detection systems. Silver Fox's 5-foot fuselage, detachable wings, and tail fins fit into a super-sized golf bag making storage and transportation simple and efficient. Unlike other UAV systems, which require a skilled radio-control operator or pilot, Silver Fox is easy to fly and allows the operator to program routes into a laptop computer

Those are some of our highlights for the near-term – “Today’s Navy and Marine Corps”. Naval science and technology is a sustained journey from discovery to deployment in which innovation (invention) and experimentation (validation) transform the operating forces. This is a continuous cycle, so I would like to discuss the “Next Navy and Marine Corps” (roughly the forces that will emerge over the next five to fifteen years), and finally the “Navy and Marine Corps After Next”—which we will see in fifteen to thirty years.

A great deal of our transformational effort is lodged in the Future Naval Capabilities (FNC). Science and technology enable Navy transformation by achieving the FNCs’ goals. The key to successful transformation is the strong business partnership among scientists, industry, requirements, acquisition, and warfighters.

We have focused a major portion of our S&T portfolio on FNC for the “Next Navy and Marine Corps.” Approximately two-thirds of our 6.3 (Advanced Technology Development) funds and about 40% of our 6.2 (Exploratory Development) funds are invested in the FNCs. The FNC process delivers maturing technology to acquisition program managers for timely incorporation into platforms, weapons, sensors, and process improvements. Each of the current 12 FNC focus areas is planned and reviewed by an integrated team with representation from the Office of Naval Research, a Program Executive Office (PEO), the Navy and Marine Corps requirements community, and the Fleet/Force user community. This gives us constant validation

of the relevance of the technologies, and strong buy-in and commitment to transition plans. We have recently strengthened alignment of the FNC process with the Naval capabilities development process, which establishes our program requirements and priorities in Sea Strike, Sea Shield, Sea Basing and FORCEnet.

The current FNCs, in no priority order, are:

- **Advanced Capability Electric Systems** – The future of naval warfare is electric. Warships will have revolutionary power plants that permit new hull forms and propulsors, reduce manning, streamline logistics, power advanced sensors, and enable future high energy and speed-of-light weapons. We have already successfully transitioned the Aircraft Electrical Servicing Station, a solid state, re-programmable, reliable, high quality deck edge power source for aircraft servicing, and the Reconnaissance, Surveillance and Targeting Vehicle, which demonstrates key hybrid electric components such as Li Ion Battery Pack, power electronics, and in-hub wheel motors in an integrated system demo. In fiscal year 2005 we will transition work on our Ships Service Fuel Cell to the DD(X) program. Fuel cell technology has the potential to significantly reduce fuel consumption, and can also provide distributed power generation, improving the ship’s “fight through” ability. This FNC is aligned most closely with *Sea Strike*, *Sea Shield*, and *Sea Basing*.
- **Autonomous Operations** – This program is pursuing a dramatic increase in the performance and affordability of Naval air, surface, ground, and underwater autonomous vehicles—unmanned systems able to operate with a minimum of human intervention and oversight. The Autonomous Operations FNC gives us a great potential to operate effectively in what would otherwise be denied areas. It contributes to *Sea Shield* and *Sea Strike*. In fiscal year 2005, for example, we will transition the Modular Mission Payload Architecture to the Fire Scout Vertical Tactical UAV. The prototype system is being used to control the ISR payload on the Spiral 1 Spartan USV, which is currently deployed on the USS Gettysburg in the Middle East.
- **Fleet/Force Protection** – We have very capable ships, aircraft, and ground combat vehicles. It’s our business to ensure that they don’t fall to the sorts of asymmetric threats our enemies pose. This FNC, aligned with *Sea Shield*, is working to develop effective organic means of

protection: weapons, sensors, countermeasures, stealth and damage control. It has already transitioned the initial phase of the ES Detection of LPI Periscope Detection Radars project to Office of Naval Intelligence as part of their Cluster Pennant Program. In addition, this S&T program is transitioning as an upgrade to NAVSEA's AN/BLQ-10 Submarine ES System.

- **Knowledge Superiority and Assurance** – Information technology is as crucial to naval superiority as it is to any other aspect of contemporary life. This program is developing our ability to distribute integrated information in a dynamic network with high connectivity and interoperability. It will ensure knowledge superiority, common situational understanding, and increased speed of command. This FNC is a key enabler of *FORCEnet*. It recently provided a prototype Image Processing and Exploitation Architecture tool to the I MEF for deployment on UAVs in Iraq and Afghanistan. This tool provides a geo-referenced composite picture of imagery that builds over time as UAV sensors conduct searches of areas of interest. The picture provides a substantial enhancement to standard imaging techniques that only provide a view of what the sensor sees at any particular point in time. The Knowledge Superiority Assurance FNC has also provided tools that significantly improve our ability to process signals intelligence and weather information in-theater. In fiscal year 2005, this FNC plans several transitions to significantly improve time-sensitive decision making, apertures, networking, interoperability, and the next generation common picture.
- **Littoral Antisubmarine Warfare** – This program is part of our shift in emphasis to littoral, expeditionary operations. The antisubmarine warfare challenge in coastal waters is a tough one so, we are focusing scientific efforts on enhancing our ability to detect, track, classify, and engage enemy submarines by using a layered tactical ASW approach. We do this by first countering enemy submarines near shore, followed by addressing threat submarines prior to their torpedo launch, and then countering any threat torpedoes after launch. Each layer by itself will effectively address its individual objective; and when the layers are viewed in their entirety, it offers an effective “system-of-systems” approach that we believe will adequately address the ASW problem. A number of products have transitioned to acquisition systems including Sonar Automation Technology processing techniques that provide automated detection and classification operator alerts to submarines and surveillance

platforms, reducing operator workload and increasing performance capability. *Sea Shield* is benefiting from the products of this FNC.

- **Littoral Combat and Power Projection** - This FNC has two major thrusts: Expeditionary Logistics (aligned with *Sea-Basing*) and Littoral Combat (essential to *Sea Strike*). This FNC focuses on deploying uniquely capable combat and logistics systems necessary to deploy and sustain the Fleet and the Force without building up a large logistical infrastructure ashore. This year, the Expeditionary Logistics Program successfully tested a set of automated Logistics Command & Control/Decision Support Tools essential to the Marine Air Ground Task Force (MAGTF). They have set the stage for transition of a Ground Logistics Command and Control Combat Service Support “Toolkit”. The Toolkit will provide proactive rapid request support for personnel, equipment, and services, logistics mission planning and execution support, after-action assessment tools, and situational awareness projection onto the Marine Corps common operating picture. Littoral Combat FNC plans a fiscal year 2005 transition of the EX-45 Stabilized Gun Mount which will use advanced software to sense and compensate for motion about train and elevation axes. The gun mount which additionally houses an Embedded Video Tracker is compatible with the MK-19 40mm, M2 .50 caliber and M240G 7.62 weapon systems. The stabilized, adaptive mount coupled with an auto-tracking feature will significantly enhance warfighting capability in both surface vessel and vehicular applications. Also planned for transition in fiscal year 2005, the Expeditionary Decision Support System (EDSS) software application is designed to support operations ranging from amphibious landings to combat operations ashore. Resident within the application are scheduling engines, computational models, performance algorithms, and the ability to collaboratively access common databases. EDSS’s high degree of military utility has garnered substantial warfighter interest and as a result has deployed with Marine Expeditionary Units (MEU) and Naval Expeditionary Strike Groups (ESG) in support of Operations Enduring Freedom and Iraqi Freedom. The Direct Reporting Program Manager Expeditionary Fighting Vehicle (DRPM EFV) will transition the secure wireless local area network (LAN) and related technologies to enhance the information exchange between individual EFVs, between EFVs and dismounted troops, as well as between EFVs and the ships and operations centers with which they operate.

- **Missile Defense** – This program is focused on technology enabling and supporting lethal engagements of theater missiles, manned and unmanned aircraft at extended ranges in defense of naval forces and assets afloat and ashore. Products being worked will offer ways to expand the battlespace rapidly, identify contacts accurately, and engage threats effectively and efficiently. This year, as part of the Composite Combat Identification project, the Missile Defense FNC will transition advanced algorithms to correlate real-time track files with signals intelligence data and other information files resident in the EP-3E ARIES II surveillance aircraft. When this capability is operational, derived identification information will be provided to fleet tactical users in real-time. As part of the Reactive Materials Warhead project, test results and warhead design parameters of a first generation reactive materials warhead will be available with the goal of high lethality against cruise and ballistic missile targets. In September, there will be an important demonstration at the Combat Systems Engineering Design facility of our Distributed Weapons Coordination capability. These automated battle management algorithms will provide real time priority Threat Evaluation considering all air threats and all defended assets, at sea and ashore. Recommendations of Preferred Shooter will also be developed considering location, current weapons load and optimal end-game geometry for both ballistic missile defense and defense against “air breathing” threats. In early fiscal year 2005, we will complete development and testing of highly mobile X-band radar technology in the Affordable Ground Based Radar project as a risk reduction concept demonstration for the Marine Corps Multi-Role Radar System (MRRS). The Missile Defense FNC is a strong contributor to the Sea Shield and FORCEnet pillars of the Navy’s Sea Power 21 operational concept.
- **Organic Mine Countermeasures** – Because they are cheap, and able to seed the battle space with a menace far out of proportion to their numbers, mines have been and will continue to be deployed against us by terrorists and their state sponsors. We’re working to give our forces an organic—that is to say, an inherent—and stand-off ability to detect, characterize, and neutralize mines wherever they may be encountered. Closely aligned with *Sea Shield*, this FNC has transitioned several important products. One of them, the REMUS autonomous underwater vehicle, is now in the hands of our operating forces in Iraq where it helped clear the rivers to speed supplies to troops. It was also pressed into service in the weeks immediately following 9/11 to help secure ports on both of our coasts. I might mention that

REMUS emerged from a basic oceanographic research program—another piece of evidence that overnight successes are long in preparation.

- **Time Critical Strike** – We are substantially reducing the amount of time it takes to hit critical mobile targets, like theater ballistic missiles launchers, command centers, and weapons of mass destruction. One of this FNC’s products, the Affordable Weapon System, a loitering cruise-missile-like system that can carry a variety of payloads, is currently transitioning to the acquisition community for development this year. Time Critical Strike is aligned with *Sea Strike*.
- **Total Ownership Cost** – This FNC uses advanced design and manufacturing processes to significantly decrease the cost of buying, operating, and maintaining Navy systems while promoting increased system readiness. We are working to reduce total lifecycle costs during design and manufacturing as well as increase savings realized from reduced manning and better environmental compliance. Aligned primarily with *Naval Enterprise*, this FNC has transitioned a number of programs to the user community. The Total Oil Monitoring System is designed for real-time, online applications and will transition to Navy surface ships to monitor critical machinery. The Rapid Cure Ship Tank Coatings Program has been demonstrated in 14 ship tanks and voids. Aircraft corrosion sensors, developed under the Corrosion and Corrosivity Monitoring System Program have been installed on an H-60 helicopter for flight testing. The Turbine Engine Technology Program delivered a thermal barrier coating with significantly reduced thermal conductivity that was selected for inclusion in the F135 (Joint Strike Fighter) engine. In fiscal year 2005, we will transition a Portable Wide Area Non Destructive Inspection Imager that maps surface corrosion and subsurface defects without removal of paint. Payoffs include faster, more reliable aircraft inspection, improved prognostics, longer aircraft life, lower repainting costs and improved safety.

The relatively mature technologies managed in FNCs do not spring up overnight. In many cases they are the result of long term investments in research and invention programs in 6.1 and early 6.2 funding categories. We focus our research and invention investments on areas where the Navy is the only significant U.S. sponsor (such as Ocean Acoustics and Underwater Weaponry), and on S&T Grand Challenges whose solution would provide significant advances

in Naval capability (such as Naval Materials by Design). A stable, long term discovery and invention program is essential to keep our pipeline full of enabling technologies and to attract the nation's best scientific talent to focus on Naval problems.

Finally I would like to talk about the “Navy and Marine Corps After Next”—the fleet and force we will see in fifteen to thirty years. We are continuing to support our Grand Challenges and the National Naval Responsibilities as well as our Innovative Naval Prototypes. The Naval Science and Technology Grand Challenges are large, difficult, challenges that, if met, could give us decisive capabilities fifteen to thirty years in the future. We encourage the nation's scientific community to achieve breakthroughs in difficult but achievable scientific challenges like Naval Battlespace Awareness, Advanced Electrical Power Sources for the Navy and Marine Corps, Naval Materials by Design, and Multifunctional Electronics for Intelligent Naval Sensors. The National Naval Responsibilities are fields in which the Department of the Navy is the only significant U.S. sponsor. These include fields like Naval Engineering, Ocean Acoustics, and Underwater Weaponry. If the Department of the Navy didn't invest in them, it is unlikely that anyone would. It is vital to keep such fields healthy, not only for the sake of our own capabilities, but to avoid technological surprise as well.

I am excited about what I call Innovative Naval Prototypes. These are the capabilities that promise to fundamentally change how we prepare for and fight wars. Examples include: the free electron laser, the electromagnetic railgun, hypersonic missiles, the x-craft, and superconducting electric drive motors. The Secretary of the Navy and the Chief of Naval Operations are committed to making the electric ship our ship of the future and we are providing the science and technology. We are well down the path to building the electric propulsion and weapons. The 36 megawatt motor effort is underway and we are using the lessons learned from ongoing testing of the 5 megawatt motor. The Free Electron Laser is progressing to its next demonstration at 10 kilowatt. In addition, we are working collaboratively with the other services, as directed by the Congress, on electromagnetic rail gun technology for the future.

Construction is underway on the high speed, experimental vessel called Littoral Surface Craft – Experimental, or “X-Craft.” This high speed aluminum catamaran will test a variety of

technologies that will allow us to improve our capabilities in littoral, or near-shore, waters. The X-Craft will be used to evaluate the hydrodynamic performance, structural behavior, mission flexibility, and propulsion system efficiency of high speed vessels. X-Craft will eventually be fitted with an advanced lifting body component. The lifting body component is a streamlined underwater appendage that will dampen low-speed ship motions, increasing the operational envelope for helicopter and small craft operations. Liquid polymers will be used on the surface of the lifting body to evaluate drag reduction.

The X-Craft will be the first Navy purpose built ship to demonstrate mission flexibility. Mission flexibility will be demonstrated through interchangeable “mission modules” housed in the X-Craft’s large Mission Bay in standard twenty-foot container boxes. The Mission Bay will be capable of housing twelve containers, permitting the vessel to be quickly reconfigured to support a variety of potential missions, including battle force protection, mine counter-measures, amphibious assault support and humanitarian support. A multi-purpose Stern Ramp will allow X-Craft to launch and recover manned and unmanned surface and sub-surface vehicles up to the size of an 11 m Rigid-Hull Inflatable Boat (RHIB). From its flight deck, X-Craft will be able to support 24-hour a day operations for up to two MH-60S helicopters.

In conclusion, the nation’s return on investment is clear. Naval transformation depends on a long-term, stable and sustained investment in science and technology. We validate through a cycle of on-going experimentation and validation so we can transition new capability to the warfighter.

Thank you for the opportunity to testify.