

NOT FOR PUBLICATION
UNTIL RELEASED BY THE
SENATE ARMED
SERVICES COMMITTEE

STATEMENT OF

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BEFORE THE

SENATE ARMED SERVICES COMMITTEE

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ON

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Mr. Chairman, distinguished members of the subcommittee, thank you for this opportunity to discuss Naval Science and Technology. You and the other members of the Senate Armed Services Subcommittee on Emerging Threats and Capabilities have been leaders in calling attention, both nationally and in the Department of Defense, to the importance of moving new technology quickly from the scientist's bench to our Sailors and Marines.

As Commander, Naval Air Systems Command (NAVAIR), I oversee the operation of two Naval Air Warfare Centers. My counterparts at Naval Sea Systems Command (NAVSEA), Space & Naval Warfare Systems Command (SPAWAR), and the Office of Naval Research (ONR), operate an additional six Naval Surface Warfare Centers, three Naval Undersea Warfare Centers, three Space and Naval Warfare Systems Centers, one Naval Research Laboratory and numerous other field activities. Among us we cover the wide range of technologies the Navy and Marine Corps use. We report to the Assistant Secretary of the Navy for Research, Development and Acquisition. I think this division of labor has proven valuable in allowing the separate Systems Commands to better focus their resources on their applicable technologies.

As the senior Naval officer directly responsible for many of the issues being covered today, I have been asked to represent all of the Navy Systems Commands and the Office of Naval Research. We collaborate closely, and we face similar challenges, particularly with respect to attracting and retaining technical talent. I will address some of those challenges later in my statement.

Let me begin, with an overview of our scientific and technological portfolio. The return on the Nation's investment in Naval science and technology is measured in capabilities. This is particularly important in a time when we must not only fight and win a global war, but also transform the Navy and Marine Corps. We hear a great deal about al Qaeda and others posing an "asymmetric threat" to us. But our scientific and technological edge gives us a tremendous asymmetric advantage over our enemies. We've already seen some of that advantage at work in Operation Enduring Freedom, and Naval transformation will depend on our ability to sustain and exploit our lead in science and technology. To do that you need a long-term, stable, and sustained investment in science and technology transitioning to research and development,

validated through on-going experimentation, with transition to the Fleet and Force in a continuous cycle of progress.

It is difficult to exaggerate the importance of sustained scientific effort: investment in research is always a long proposition. We have seen some very quick delivery of new, advanced capabilities already in this war. These can seem like overnight successes. Take the thermobaric bombs our forces dropped on al Qaeda and Taliban positions last year in Gardez, Afghanistan. That thermobaric fill—developed at Naval Surface Warfare Center Indian Head, and weaponized by the Navy in collaboration with the Defense Threat Reduction Agency and the Air Force—was more than 30 years in preparation. This particular Naval investment in basic, synthetic organic chemistry (for that’s what produced thermobarics) began in the late 1960s after the disastrous accident and fire aboard USS FORRESTAL. So basic science answered a Naval need, and the necessary work had been done to produce an effective, new class of weapons. You might consider it an overnight success that depended on 30 years of work.

With this in mind, I am pleased to report that the Department of the Navy’s science and technology funding has shown real growth from FY 2003 to FY 2004 (based on comparison of the President’s Budget Requests for those years). This is our positive response to the Defense guidance and Congressional mandates that have called for more Defense science and technology funding. During FY2004 budget development, the Department of the Navy’s Science and Technology Future Years Defense Plan (FY 2004-FY 2009) was increased by a net \$1.45B.

The significant increases in FY 2004 include programs that are both transformational and bear directly on the current war:

- Naval Unmanned Combat Air Vehicle +\$98M
- National Aerospace Initiative-Supersonic Cruise Missile +\$22M
- Strategic Systems Infrastructure +\$20M
- Joint Project Office - Special Technology Countermeasures +\$14M
- US Coast Guard Vessel Tracking +\$10M

The Department of the Navy is gratified by consistent Congressional support of our science and technology program. We trust that we are managing that support effectively to achieve the objectives of our program.

We are particularly gratified by Congressional interest in testing and evaluation—we owe Sailors and Marines the assurance that the systems we put in their hands work as advertised, especially when they're delivered under wartime exigencies. Regarding, for example, the Defense Test Resource Management Center Congress has recently mandated, the Department of the Navy certainly supports the concept. We are working with the Under Secretary of Defense for Acquisition, Technology, and Logistics to support the establishment of this new field activity, and we look forward to supporting its mission.

Let me return to my earlier theme of transformation in a time of war. To keep perspective, recall that transformation occurs over the near-term, mid-term, and long-term. Naval science and technology is a sustained journey from discovery to deployment in which innovation (invention) and experimentation (validation) transform the operating forces. Because this is a continuous cycle, we find technological advance in “Today’s Navy and Marine Corps,” the “Next Navy and Marine Corps” (roughly the forces that will emerge over the next five to fifteen years), and the “Navy and Marine Corps After Next”—which we will see in fifteen to thirty years.

How do we choose where we invest? We are guided by:

- ***Programs for Rapid Response***—immediate feedback from the operating forces. We get this through participation in experimentation with those forces, in exercises like Millennium Challenge, through the Naval Research Science Advisors posted to the staffs of each major Navy and Marine Corps Command, and through our Tech Solutions initiative. When an immediate challenge, problem, or opportunity lends itself to scientific resolution, we are able to shift a relatively small but nonetheless crucial investment to a decisive area.
- ***National Naval Responsibilities***—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's unlikely that anyone would. It's vital to keep such fields healthy, not only for the sake of our own capabilities, but to avoid technological surprise as well.

- ***Naval Science and Technology Grand Challenges***—big, 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.
- ***Future Naval Capabilities (FNCs)***—programs to shape the next Navy and Marine Corps. Developed and managed by integrated product teams with members of the acquisition, requirements, science and technology, resource, and above all warfighter communities, the Future Naval Capabilities fill the gap that all too often opens between science and technology on the one hand and acquisition on the other.

A great deal of our transformational effort is lodged in the Future Naval Capabilities. 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.

The FNC process delivers maturing technology to acquisition program managers for timely incorporation into platforms, weapons, sensors, and process improvements. With a total investment of \$577.6 million in FY02 and over \$640 million in FY03 and \$500 million planned for FY04, FNCs support the Secretary of the Navy's goals to 1) increase combat capability, 2) enhance personnel performance, 3) introduce advanced technology, and 4) improve business practices.

The Office of Naval Research devotes approximately two-thirds of its 6.3 (advanced technology development) funds and about two-fifths of its 6.2 (applied research) funds to Future Naval Capabilities. As you know, we currently have twelve approved Future Naval Capabilities.

I'll describe each one briefly, and provide the basics as to where it fits into the Department of the Navy's concept of Sea Power 21:

- **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 Future Naval Capability gives us a great potential to operate effectively in what would otherwise be denied areas. It contributes to *Sea Shield* and *Sea Strike*. In FY 2004, for example, we will transition the Gladiator Tactical Unmanned Ground Vehicle to the Marine Corps. Gladiator is intended to support dismounted infantry across the spectrum of conflict and throughout the range of military operations. It will enhance tactical commanders' ability to detect, identify, locate, or neutralize a broad range of threats.
- **Capable Manpower** – The focus here on affordable human-centered systems that give our Sailors and Marines the ability to operate effectively under conditions an enemy can barely survive. The primary goal of this program is to get the right person in the right job with the right training at the right time in order to meet the needs of the Navy and Marine Corps. A great deal of progress has been made in this last area. In particular, two products have already transitioned: Models of Navy Compensation and Personnel Behavior (MODCOMP)—a tool for manpower analysts to rapidly develop retention forecasting models through ready-access to relevant data sources, intuitive linkage to highly sophisticated statistical tools, and export capability to populate existing decision support tools, and Comprehensive Officer Force Management Environment (CHROME)—a tool for monitoring actual officer inventory behavior and a 12-month loss-forecasting model to predict officer losses for each primary category. Capable Manpower is most directly aligned with *Sea Warrior*.
- **Electric Warships and Combat Vehicles** – The future of Naval warfare is electric. Warships will have revolutionary power plants that permit new hullforms and propulsors, reduce manning, streamline logistics, power advanced sensors, and enable future high energy and speed-of-light weapons. We have already successfully demonstrated the essential elements of a high temperature superconducting motor for the next generation of

warship, and a hybrid diesel-electric reconnaissance vehicle for the Marines. This Future Naval Capability is aligned most closely with *Sea Strike*, *Sea Shield*, and *Sea Basing*.

- **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 Future Naval Capability, aligned with *Sea Shield*, is working to develop effective organic means of protection: weapons, sensors, countermeasures, stealth and damage control. It has already transitioned Real Time Damage Detection, Assessment, and Response to acquisition. As well, the President's Budget for Fiscal Year 2004 supports the execution of full-scale development of an Integrated Torpedo Defense System for protection of heavy combatants and amphibious forces operating in the challenging littoral environment. This effort is the culmination of support, from the Congress, for torpedo defense R&D activity over the past several years, and is focused on the ability to rapidly deliver threat-sensitive capabilities to the Navy's high value forward deployed assets.
- **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. Knowledge Web technology from this program has been deployed with the USS Carl Vinson Battle Group, engaging the enemy in Operation Enduring Freedom. This Future Naval Capability is a key enabler of *FORCEnet*.
- **Littoral Antisubmarine Warfare** – This program is part of our shift of emphasis to littoral, expeditionary operations. The antisubmarine warfare challenge in coastal waters is a tough one, so we focus scientific effort on enhancing our ability to detect, track, classify, and engage enemy submarines in a near-the-shore environment before they are close enough to harm our forces. A number of products have already entered acquisition from this program: the Environmentally Adaptive A/N SQQ-89 sonar instrumented tow cable fibers and signal processing, for example. *Sea Shield* will benefit from the products of this Future Naval Capability.

- **Littoral Combat and Power Projection** - This Future Naval Capability has two major thrusts: Expeditionary Logistics (an important step toward *Sea-Basing*) and Littoral Combat (essential to *Sea Strike*). It 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. The program has already transitioned a baseline logistics command and control system for expeditionary warfare.
- **Missile Defense** – This program is directed at the threat expeditionary forces face from cruise missiles. In particular, it’s working toward the ability to track and destroy overland cruise missiles that threaten both ships at sea and Marines ashore. It will also contribute to our general air defense capability through a single integrated air picture, composite combat identification, distributed weapons control, and overland intercept capability. This new capability will greatly mitigate the likeliest and most dangerous air threat to our forces. The Missile Defense Future Naval Capability is nearing transition in several of its product lines, including, for example, the Reactive Materials Warhead and Affordable Ground-Based Radar. Missile Defense forms an important part of *Sea Shield*, but this shield is extended to cover forces ashore, as well.
- **Organic Mine Countermeasures** – Mines are a cheap, deniable, and able to infest the battlespace 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—ability to detect, characterize, and neutralize mines wherever they may be encountered. Closely aligned with *Sea Shield*, this Future Naval Capability has transitioned several important products. One of them, the REMUS autonomous underwater vehicle, is now in the hands of our operating forces. It was pressed into service in the weeks immediately following 9/11 to help secure ports on both of our coasts. REMUS emerged from a basic oceanographic research program—another piece of evidence that overnight successes are long in preparation.
- **Time Critical Strike** – Here we are substantially reducing the amount of time it takes to hit critical mobile targets, like theater ballistic missiles, command centers, and weapons of mass destruction. One of this Future Naval Capability’s products, the Affordable Weapon (a loitering cruise-missile-like system that can carry a variety of payloads) is

being deployed to the CENTCOM area of responsibility soon. Time Critical Strike is aligned with *Sea Strike*.

- **Total Ownership Cost Reduction** – This Future Naval Capability is using advanced design and manufacturing processes to decrease significantly the cost of buying, operating, and maintaining our systems. We are working to reduce total lifecycle costs, and that includes obvious work in design and manufacturing as well as less obvious savings realized from reduced manning, better environmental compliance, and more sophisticated cost-estimating tools. Aligned most especially with *Sea Enterprise*, this Future Naval Capability has transitioned a number of products to industry. One example includes advanced coating techniques for hot-running turbine engines.
- **Warfighter Protection** – Improved casualty prevention, care, and management are the goals of this Future Naval Capability. Aligned with *Sea Shield* and *Sea Warrior*, this program has already transitioned a life-saving clot-inducing bandage to our forces in Afghanistan.

Our investment portfolios are not built in isolation. The Defense Reliance process integrates the Services' science and technology programs while preserving the healthy diversity of vision and approach that has given us the technical agility we enjoy today. And our relations with the Defense Advanced Research Projects Agency (DARPA) are excellent and productive. Much of the Office of Naval Research's basic and applied research investment is designed with a view to handing scientific advances over to DARPA for further development and exploitation. The Unmanned Combat Air Vehicle – Naval (UCAV-N) program is an excellent example of this kind of collaboration.

I will now address some of our challenges concerning the health of the Navy's Laboratories and Warfare Centers. The Naval Research & Development Centers, which include the SYSCOM Warfare Centers, the Naval Research Laboratory (NRL) and the Medical and Health Research Centers, employ world-class technical experts who execute much of the Navy's science and technology portfolio, developing innovative solutions and transformational capabilities for the Navy and Marine Corps. These centers, spread throughout the United States, currently employ around 40,000 civilians, about half of who are scientists and engineers. They

perform cutting edge work upon which we depend to preserve its military superiority. The effectiveness of the war-fighting systems employed by the Navy and Marine Corps of the Future depends as much on investment in these dedicated, capable civil servants as it does on the size of the science and technology budget itself.

The past decade's frequent downsizings, coupled with the declining number of American students—particularly women and minorities, pursuing mathematics, engineering and physical science degrees—has left us with a dwindling pool of scientists and engineers available to become the next generation of researchers. This situation jeopardizes our ability to perform essential research in support of, ultimately, Sailors and Marines.

Recent warnings about the decline of the Navy's S&T workforce come from a variety of sources. In the Naval Institute's *Proceedings*, Dr. James E. Colvard, former director of civilian personnel policy for the Department of the Navy and chair of the panel that developed the report, "Civilian Workforce 2020, Strategies for Modernizing Human Resources Management in the DON" notes the Navy has "put its institutional capability in science and engineering at peril." Colvard also comments, "The Navy has lowered its level of intellectual involvement in research and development and weakened its entire infrastructure, which at the end of WWII was the strongest in the world."

The DoN's "Civilian Workforce 2020" study pinpointed workforce modernization as the defining issue pushing S&T revitalization. The study concluded: "It is not possible to achieve a functional workforce that is prepared to meet the management, technical, and political challenges of the future without investing financial resources and leadership attention."

Recently, a tri-Service laboratory study chartered by the Director, Defense Research and Engineering, and carried out under the auspices of the Naval Research Advisory Committee produced a report: *Science and Technology Community in Crisis*. In the report, the panel commented that all of the laboratories they visited reported that "maintaining a quality scientific and engineering staff is growing more difficult." The report continued: "The real issue is not whether the laboratories can muddle through under the current system and fill Science &

Engineering vacancies with entry-level personnel. It is whether they can compete effectively for, and retain, the best and brightest technical talent, e.g. the top 10 percent.”

A total commitment to improving our ability to attract and retain a cadre of world-class scientists and engineers will be necessary to meet the simultaneous challenges of performing transformational research while replenishing the aging talent base. Simple demographics show that over the next 10 years we will lose most of our current workforce. Although some organizations are holding their own in recruitment, many indicators are going negative, and managers report greater difficulty in hiring quality scientific personnel. If we cannot invest at an appropriate level in promising research scientists and engineers today, we believe that the options and opportunities the Naval R&D labs and center have provided our fighting forces for more than the past 60 years or more will begin a decline that will be difficult to reverse.

The Navy has launched an initiative called “N-STAR”—Naval Science and Technology for Advancing Revitalization. This program is addressing the personnel issues associated with: refreshing our technical workforce with the small pool of recruits available to fill positions vacated by retiring scientist and engineers, and with the professional and technical enhancement of the current workforce as they move into senior positions at the Naval Research and Development Centers. N-STAR is a collaborative effort, concentrating on integrated relationships with partners within the university community and other federal agencies interested in the future of the nation’s scientific and engineering workforce.

In Fiscal Year 1995, Congress provided the Department of Defense labs with the opportunity to test a variety of new personnel tools. Section 342 of the Fiscal Year 1995 National Defense Authorization Act permitted some of our labs and centers to implement a number of personnel reforms not previously available. The personnel initiatives being tested under this program have broad acceptance and are achieving very positive results.

For several years now, the Department of Defense has been actively testing many management flexibilities, i.e. pay banding, pay for performance and simplified classification. Acknowledging the success of the demonstration projects and alternate personnel systems, the

Under Secretary of Defense for Personnel & Readiness began a review of the personnel management flexibilities already in use within the Federal Government. Multi-Component, multi-functional work teams and senior functional executives completed this yearlong review that identified "best practices" - those with the highest rate of success. The Office of the Secretary of Defense is considering many of these best practices for inclusion in a legislative proposal on human resource management.

In conclusion, the return on the nation's investment is clear. Naval transformation depends on a long-term, stable, and sustained investment in science and technology, validated through on-going experimentation and transition to the warfighter in a continuing cycle.

Mr. Chairman, thank you again for the opportunity to share with the Subcommittee some of the good things the Navy is doing in the S&T world.