STATEMENT OF

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BEFORE THE

SUBCOMMITTEE ON EMERGING THREATS AND CAPABILIES

OF THE

SENATE ARMED SERVICES COMMITTEE

ON

FY 2000 SCIENCE AND TECHNOLOGY PROGRAMS
IN THE DEPARTMENT OF THE NAVY

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Mr. Chairman, distinguished members of the Subcommittee, thank you for this opportunity to discuss the Department of the Navy's Science and Technology Program and our FY 2000 budget request.

Today, the dangers we face beyond our borders are unprecedented in their complexity. Our ability to respond to future operational requirements commits us to support the Navy and Marine Corps Team through a strong technological and industrial base that can propel us into the 21st Century. If we do not lead the technological revolution, we will be vulnerable to it. Last year at least 25 countries experienced small-scale conflicts—small compared to the world wars of this century but large enough for those engulfed by them. As we continue our national policy of engagement and take part in the promise of global prosperity, we will likely find the Navy and Marine Corps increasingly involved in this type of regional conflict. To contain these conflicts, to stop them early or, if possible, to deter them completely, we will need every advantage that Science and Technology can provide us.

The superior technology we enjoy today rests on a foundation of basic research laid years ago. From our Basic Research Program through our Manufacturing Technology Program, Naval science and technology are the keystone that maintains “Forward . . . from the sea” superiority at an affordable cost. The capabilities that make today's formidable and extremely effective Navy and Marine Corps Team second to none are the result of our programs in Science and Technology. Our programs continue to integrate performance, discovery, and invention; combining the intellectual power of U.S. academia with the entrepreneurial spirit of American industry.

In use in the battlefield today are technologies that, funded by the Navy, have come to fruition. Below are several examples:

Specific Emitter Identification (SEI)

SEI technology extracts subtle but persistent features contained within the received radar signal to create a fingerprint unique to a specific radar. Unlike conventional systems which only extract obvious features such as frequency and pulse-repetition-rate, scan, and similar parameters, which can be grossly ambiguous for emitter identification, the SEI technology provides hardware specific identification. ONR has invested in this technology for more than a decade, and there are currently 20 such systems

which moved directly from the lab and are now in operational use, one on each of two ships and a helicopter in the Balkans.

ALE-50 Decoy

The ALE-50 contributes to full-dimensional protection by improving individual aircraft probability of survival. Technological development for the ALE-50 (V), employed by the USAF for Kosovo Operations, started under the ONR base program in 1975 when the Navy Research Laboratory demonstrated a single tube ultra-wide band 3-18GHz Traveling Wave Tube. Raytheon Systems, Inc. is on contract for the production version of the ALE-50, and its basic ALE-50 system consists of a launcher, a launcher controller and the towed decoy. The decoy control/monitor electronics and power supply are contained in the launch controller. The launcher, which holds a number of decoy magazines, can be customized to fit many different aircraft. Reports from both F-16 and B-1 pilots have indicated that the system operated effectively.

MJU27B Infrared (IR) Flare

This 6-inch expendable flare uses special IR materials that optimize its IR signature against the seekers of IR surface-to-air missiles. This means that this flare, which burns in the IR frequency, is invisible to the naked eye but is effective in leading IR seeking surface-to-air missiles astray. Both Navy and Air Force aircraft use the MJU27B.

Distant Thunder

Funded jointly by ONR and DARPA, the Distant Thunder sonar system recently demonstrated its potential as an effective ASW tool in a difficult acoustical environment off the coast of South Korea. The test area contained severely sloping bathymetry and highly variable propagation conditions. In spite of these conditions, and with the added challenge of a typhoon passing through the region, the sonar system detected and processed data from three multi-static events. Fleet sonar experts operated the Distant Thunder processors and detections were made on both U.S. and Republic of Korea submarines, acting as targets.

Laser Line Scan

The Laser Line Scan System (LLSS), based on laser technology that is integrated with a side scan sonar and precision navigation equipment, has

been developed for use in mine countermeasures. The LLSS is attached by an electrical cable to a survey ship and is towed just above the sea floor. It produces detailed video images over 10 to 200 foot-wide swaths of the sea floor, depending on visibility. The technology provides a clear view of the sea floor that can enable scientists and investigators to see details of objects less than one-half-inch in size. The LLSS can cover an area up to five times larger than conventional underwater cameras while retaining fine detail. The LLSS has been used very successfully for wreckage recovery efforts in the Swiss Air crash off the coast of Nova Scotia. An earlier version of the system was used to investigate the crash of TWA Flight 800 off the coast of Long Island, NY. The LLSS presents great promise in the mine countermeasures arena.

Tactical Atmospheric Modeling System/Real Time (TAMS/RT)

The Naval S&T program has just completed demonstration of a very high resolution numerical weather prediction system run locally at the Naval Meteorology and Oceanography Facility in Bahrain. The system enables rapid turn-around, highly accurate forecasts of local weather, and can drive weather-dependent tactical models such as chemical and biological agent transport prediction models. Also using TAMS/RT technology, forecasters can obtain very accurate, high-resolution meteorological predictions for localized areas. Missiles, which are sensitive to wind and temperature, can then be programmed according to these forecasts, or, if the predictions are for extreme conditions, missile launches can be canceled. The demonstration, commenced in December 1998, has been highly successful and provided critical support to operations over Iraq and in the Persian Gulf. Commander, Naval Oceanography and Meteorology Command, has accepted the system for transition to operations and intends to install systems at all METOC centers world wide during FY00 and FY01.

Tactical Weather Radar

The Navy's SPY-1 phased-array Aegis tactical radar has just been demonstrated as a weather radar. The technology, primarily signal processing, will deliver at-sea weather information superior to current National Weather Service radar systems, while simultaneously improving tactical radar performance by removing weather-related clutter. Lockheed and the Navy, under a cost-shared cooperative agreement, will demonstrate the capability at sea onboard the USS O'Kane, DDG77, in September 1999. The National Weather Service and Federal Aviation Administration have

expressed interest in the technology as a follow-on capability to current NEXRAD WSR-88D weather radar systems.

Wireless Corrosion Sensor

The corrosion sensor system combines the bi-metallic thin film microsensor technology developed by the Naval Air Warfare Center Aircraft Division with the microelectronics and radio-frequency communications technology developed by the Systems & Processes Engineering Corporation. The system collects and stores corrosion information that can be retrieved on demand by transmitted radio signals. Long-term testing of the new system on SH-60B helicopters, which are used in all Fleet operations, commenced in April 1999.

While our budget request recognizes that the Department will rely on research and development efforts in private industry, universities, and in-house organizations, we have positioned ourselves to take advantage of new technology options using all available sources. The FY 2000 integrated Science and Technology budget request of $1.42 billion supports Basic Research, Applied Research, Advanced Technology Development and Manufacturing Technology.

6.1 - Basic Research

The goal of the Department of the Navy's Basic Research Program is to establish the knowledge base necessary for technological advancement. The Basic Research Program differs from basic research funded elsewhere in two important ways: it is driven by the needs of the Navy and Marine Corps Team, and it encourages risk-taking. The Department's Basic Research performers consist of academia, government laboratories and centers, and industry in an approximately 60-30-10 ratio. The Department's Basic Research performers consist of academia, government laboratories and centers, and industry in an approximately 60-30-10 ratio. The FY 2000 budget requests $377 million for Basic Research Programs, an increase of $15 million from the FY 1999 appropriation. Below are just two examples of our Basic Research Programs.

Combat casualties that survive the acute consequences of trauma are highly susceptible to secondary infections and sepsis. This is thought to be a consequence of immune system compromise by trauma-associated stress. Recent studies suggest that dehydroepiandrosterone (DHEA), a natural steroid, may directly antagonize the immunosuppressive effects of stress

and increase the natural resistance of casualties to pathogens present in their wounds or escaping from their intestines. DHEA administered under the skin within an hour of trauma was shown to preserve the normal functioning of the immune system and to increase resistance to bacterial challenge in animal models.

Piezoelectric materials lie at the heart of most sonar transducers, performing the essential role of electro-mechanical energy conversion, that is, generating the sound pulse from an electric signal on transmission, and converting the weak acoustic echoes into an electric signal on reception. Piezoelectric bistable materials increases the energy density of sonar transducers by ten-fold. The Navy invests in this research because it needed improved towed and conformal arrays, and no commercial research was being performed in this area.

6.2 Applied Research

Applied Research Programs provide the necessary link between scientific understanding and the proof-of-principle experiments that determine whether promising technologies can satisfy special Navy and Marine Corp requirements. We have requested $524 million for Applied Research. Two examples of recent Applied Research successes include a new gravity gradiometer and a new welding technique.

Navy-supported researchers at Yale University recently developed a new gravity-sensing instrument called the Atom Interferometer-Based Gravity Gradiometer. This gravity-sensing technology is a splendid example of advanced physics research having a direct Navy application. Gravity, as measured on the surface, is a function of the earth's density. Due to the sensor's ability to recognize extremely small changes in gravitational pull, we believe it has the potential to outperform existing technologies while reducing cost and improving reliability. The sensor will help submarines operate more safely while maneuvering undetected in the littoral zone and may also be used on mobile land or air platforms to detect underground excavations or structures. The technology may also be a boon to commercial companies involved in geophysical exploration.

Up to 25 percent of the cost of welding on ships is rework—correcting defects that occur in the initial welding process. By combining low-cost infrared sensors with predictive modeling techniques, the new

welding technique developed at Auburn University with Navy research dollars could save $10 million per year at Ingalls shipyard alone.

6.3 Advanced Technology Development

Advanced Technology Development Programs are the fruition of many research and technology programs, both long and short-term, synthesized into new systems supporting new capabilities. The goal of these is the demonstration of specific technologies for Naval systems.
The FY 2000 budget request for these programs, several examples of which are provided below, is $520 million.

A new power technology -- “Power Electronic Building Blocks” or PEBBs -- has the ability to change any electrical power input to any desired form of voltage, current and frequency output. The blocks sense what they are plugged into and what is plugged into them, and then make electrical conversion as needed through software programming. We are vigorously working with both academia and industry to perfect PEBB technology. We seek both the latest ideas and the best opportunity to harness industry’s talents to produce PEBBs in the future.

Navy researchers have also developed a technology that represents a leap in the fight against many life-threatening diseases. We have now successfully tested a human DNA vaccine directed against the malaria parasite. The vaccine produces an immune response critical to clearing this and other dangerous pathogens, and ultimately, may be used in the fight against many life-threatening diseases such as dengue fever and tuberculosis.

Condition based maintenance (CBM) technologies are maturing at a rapid rate. Ultimately, these technologies will function as equipment "watchdogs" in aging platforms, assessing the condition of critical power train, drive train, and structural components. By providing the commander with "intelligence" on the status of his equipment in real-time, these technologies will allow deployment options never before available. A new laser device developed as part of the CBM effort characterizes wear products in lubricants and hydraulic fluids. This information combined with the theory of material wear processes will make it possible to assess the need for maintenance based on condition. Besides reducing repair and replacements costs, CBM will enhance safety for Navy personnel.

Future Capability Options

Because we cannot afford to fund all the research and development programs that might have merit, we decided to maximize the potential for technological change by focusing on fewer and larger applied technology areas. We are currently evaluating those future capabilities that our warfighting leaders consider critical for future decades. While we expect this process to impact our next full programming cycle, we have already committed to "focused funding" and transitions with programs in technologies for the DD21, extending the littoral battlespace, and organic mine countermeasures. These programs are described below.

The basic and early applied work will continue to be the Department of the Navy's peripheral vision—its ability to latch onto new opportunities across technology disciplines, and retain proper stewardship of those technologies where the Navy (not industry or other government agencies) is the National lead funder, for example ocean acoustics and hydrodynamics.

Destroyer Technology

We don't know precisely what future threats surface combatants must defeat. Without a doubt there will be such threats, certainly total ownership costs is one. To meet these challenges the Office of Naval Research and the Program Execution Office for DD 21 have teamed to focus traditional pre-acquisition efforts, such as Advanced Technology Demonstrations, on addressing technology needs and providing technology options to the competing industry teams. This joint effort ensures that Navy and the industry teams receive the maximum possible benefit from the Navy's Science and Technology investment. The industry teams are working closely with the Navy team to evaluate the total range of Navy Science and Technology efforts and to identify specific programs for inclusion in the DD 21 Science and Technology Program Plan. Relevant Science and Technology projects are being modified to support system concept designs and to meet development schedules. The innovative approach used to develop Science and Technology for this program has generated a lot of interest within the Navy acquisition community and may emerge as a new standard to manage the transition of technology into the Fleet.

Organic Mine Countermeasures

The potential mine warfare threat will become increasingly common and increasingly dangerous to US expeditionary operations in the future. To speed up our response time to emergent threats, we must develop a broad range of versatile "organic" capabilities—that is mine countermine capabilities which are regularly deployed on ships and with other Navy and Marine Corps forces, not just in dedicated mine countermine platforms—to detect, clear or disable, and avoid mines. These capabilities must be as diverse as the threat environment itself—employing underwater sensors, bottom imaging, improved intelligence, breaching and neutralization, increasingly robust ship design and use of marine mammals. The effort will initially focus on water depths from 40' to the beach to support Marine Corps concepts for expeditionary warfare. The objective is to demonstrate a "System of Systems" concept for mine countermine which is based on a hierarchy of cooperating remote and autonomous platforms and in-stride, stand-off clearance operating from deep water across the beach, enabling the seamless, robust projection of power.

Extending the Littoral Battlespace

About two-thirds of the world's people live in littoral regions—the area within about 200 miles of the coast. Because of this, it is our Naval forces who are often the first called to a scene for evacuation assistance, disaster relief, traditional combat, and environmental protection. The littoral zone is a challenging military operating environment. How do we communicate reliably from ship to shore, among dispersed units ashore, and to and from aircraft engaged with both sea and shore units?

The Department of the Navy is working on technologies that will unite technical systems from many individual platforms. These larger networks will make it possible to plug every individual into the shared awareness of the wireless battlespace. The Navy-Marine Corps team is testing its ability to network tactical information in the littoral and in complex urban scenarios. Urban Warrior and Major Systems Demo I, to be conducted from coastal California all the way to Arizona during "Exercise Kernel Blitz 99," will include a technology demonstration and a major amphibious landing. The exercise, which began this March, will conclude on April 30, 1999.

Industrial Science and Technology Programs

Manufacturing Technology (MANTECH)

The Manufacturing Technology (MANTECH) program is an important element of our acquisition strategy to improve industrial productivity and make our

weapons systems and platforms more affordable. The Department of the Navy continues its commitment to MANTECH Programs in the FY 2000 budget with a request of $59 million. By looking early into Science and Technology solutions we ensure we address tomorrow's military needs by including critical manufacturing processes today. We will also continue to encourage industry to share their best manufacturing practices with one another through programs such as our Best Manufacturing Practices, which recently won the 1998 Innovations in American Government Award sponsored by the Ford Foundation and Harvard's JFK School of Government.

Dual Use Science and Technology

Dual Use Science and Technology provides incentive funding to attract commercial partners. The program satisfies both parties by sharing risks and costs and returning products and processes that have military and civilian uses. Thirty Technology Investment Agreements already have been awarded. A $45 million investment of Navy Science and Technology project funds spent has leveraged $201 million of effort.

Summary

Mr. Chairman, for over 200 years the United States has depended on its Sailors and Marines to promote peace and stability and defeat adversaries when necessary. The Navy is working to maintain its multi-mission capabilities and forward-presence posture while reducing the size of the Fleet. But shrinkage does not translate to readiness. To sustain the Navy and Marine Corps winning record, we must continue to ensure that our people have the right sensors, weapons, and platforms to meet tomorrow's threats and challenges within fiscal constraints. We appreciate this Committee's commitment to the health and stability of Science and Technology and your continued help in building a strong, balanced Navy-Marine Corps Team that will protect our nation's interests today, tomorrow and for decades to come.