Testimony Submitted by Dr. Raymond Bye, Jr. Director of Federal Relations The Florida State University Before the Subcommittee on Defense Committee on Appropriations US Senate May 12, 2010

Summary: Florida State University is requesting \$5,500,000 from the Research, Development, Test and Evaluation, Navy, Force Protection Applied Research (PE#0602123N, Line 5) for the **Integration of Electo-kinetic Weapons into the Next Generation Navy Ships Program**; \$4,000,000 from the Defense, Research, Development, Test and Evaluation, Defense-wide, Government/Industry Co-Sponsorship of University Research (PE# 0601111D8Z, Line 3)for the **Integrated Cryo-cooled High Power Density Systems;**; \$3,800,000 from the Research, Development, Test and Evaluation, Navy, Defense Research Sciences (PE#0601153N, Line 3), for the **Jet Engine Noise: Understanding and Reduction** program, and \$4,500,000 from the Research, Development, Test and Evaluation, Army University and Industry Research Centers Program (PE# 0601104A, Line 4) for the **Nanotubes Optimized for Lightweight Exceptional Strength** (**NOLES**)/**Composite Material Program**.

Mr. Chairman, I would like to thank you and the Members of the Subcommittee for this opportunity to present testimony before this Committee. I would like to take a moment to briefly acquaint you with Florida State University.

Located in Tallahassee, Florida's capitol, FSU is a comprehensive Research university with a rapidly growing research base. The University serves as a center for advanced graduate and professional studies, exemplary research, and top-quality undergraduate programs. Faculty members at FSU maintain a strong commitment to quality in teaching, to performance of research and creative activities, and have a strong commitment to public service. Among the current or former faculty are numerous recipients of national and international honors including Nobel laureates, Pulitzer Prize winners, and several members of the National Academy of Sciences. Our scientists and engineers do excellent research, have strong interdisciplinary interests, and often work closely with industrial partners in the commercialization of the results of their research. Florida State University had over \$200 million this past year in sponsored research awards.

Florida State University attracts students from every state in the nation and more than 100 foreign countries. The University is committed to high admission standards that ensure quality in its student body, which currently includes National Merit and National Achievement Scholars,

Rhodes and Goldwater Scholars, as well as students with superior creative talent. Since 2005, FSU students have won more than 30 nationally competitive scholarships and fellowships including 3 Rhodes Scholarships, 2 Truman Scholarships, Goldwater, and 18 Fulbright Fellowships.

At Florida State University, we are very proud of our successes as well as our emerging reputation as one of the nation's top public research universities. Our new President, Dr. Eric Barron, will lead FSU to new heights during his tenure.

Mr. Chairman, let me summarize our primary interest today. The first project involves improving our nation's fighting capabilities and is called the <u>Integration of Electro-kinetic</u> <u>Weapons into the Next Generation Navy Ships</u> Project.

The U.S. Navy is developing the next-generation integrated power system (NGIPS) for future war ships that have an all-electric platform of propulsion and weapon loads and electric power systems with rapid reconfigurable distribution systems for integrated fight-through power (IFTPS). On-demand delivery of the large amounts of energy needed to operate these types of nonlinear dynamic loads raises issues that must be addressed including the appropriate topology for the ship electric distribution system for rapid reconfiguration to battle readiness and the energy supply technology for the various nonlinear dynamic load systems. The goal of this initiative is to investigate the energy delivery technologies for nonlinear dynamic loads, such as electro-kinetic weapons systems, and investigate the integration and interface issues of these loads on the ship NGIPS through system simulations and prototype tests using power hardware-in-the loop strategies. To meet these research goals, the FSU facilities will be expanded with a 5 MW MVDC power converter and upgrade of the large scale real-time simulator. The results of this effort will provide the Navy's ship-builders with vital information to design and de-risk deployable ship NGIPS and load power supplies.

With significant support from the Office of Naval Research (ONR), FSU has established the Center for Advanced Power Systems (CAPS), which has integrated a real time digital power system simulation and modeling capability and hardware test-bed, capable of testing IPS power system components at ratings up to 5MW, offering unique hardware-in-the-loop simulation capabilities unavailable anywhere in the world. FSU is partnering with Florida Atlantic University, Florida International University, and General Atomics to combine the best talents for modeling and simulation of ship power systems, hardware-in-the -loop testing, power supplies for present and future electro-kinetic systems, and interfacing of the weapon to a ship power system. General Atomics will provide the power requirements for the weapons interface to the shipboard power distribution system. The National High Magnetic Field Laboratory (NHMFL) will utilize its research expertise and infrastructure for the proposed development. NAVSEA will be an advisor to the project for weapon system integration. We are requesting \$5,500,000 for this important program.

Our second project is also important to our nation's defense and involves our <u>Integrated</u> <u>Cryo-cooled High Power Density Systems</u> program. The objective of this program is to approach the goal of achieving high power densities through systems integration, management of heat generation and removal in the electrical system and minimize energy consumption and capital expenditures of large scale advanced power systems through cryo-cooled superconducting systems. The research activities are as follows: **Systems Analysis:** Extensive system modeling and simulation of the integrated electrical and thermal systems to understand dynamic performance under normal and adverse conditions is necessary to achieve an optimal system configuration. Develop prototypes of key technologies and test in hardware-in-the-loop simulations at levels of several megawatts (MW) to validate and demonstrate the advanced technologies.

Materials – Advanced Conductors, Semi-conductors and Insulation: Characterization of conductor materials (both normal and superconducting), semi-conductors (for use in power electronic components) and insulating materials (both thermal and electrical) at cryogenic temperatures to obtain the data needed to model system performance and design components for medium voltage dc (MVDC).

Cryo-thermal Systems: Optimize thermal system options, including conductive heat transfer and gas phase and fluid phase heat transfer systems. Modeling to understand effects from heat leaks from the ambient to the low temperature environment and internal heat generation are critical to successful performance. Adaptability to economical fabrication technologies is a major issue for investigation.

System Components: Consider new concepts for design of system components and interfaces to achieve optimum system integration. A 30 meter, 10KV DC cable based on 2G HTS wire will be designed, fabricated and tested to prove the concept of a MVDC superconducting shipboard power distribution system and provide validated design parameters to the Navy. NAVSEA will be a scientific adviser to the project.

We are seeking \$4,000,000 for this important program in FY 2011.

Third, I would like to tell you about our Jet Engine Noise: Understanding and Reduction Program. Engine noise from most modern tactical aircraft is dominated by the *jet noise* due to the exhaust of very high-speed (supersonic in most cases) gases from the jet engines; this portion of the noise is often referred to as jet noise. Noise levels in the vicinities of these aircraft are extremely high - often as high as 150 dB. This poses considerable risk to the health and safety of the personnel on carrier decks or near aircraft runways. These very high noise levels are also a problem due to their impact on the communities near military bases. If not properly addressed, the jet noise issue will continue to worsen since the noise footprint of future aircraft will likely be much higher due to higher exhaust velocities from their engines. Recently, the *Naval Research Advisory Committee (NARC)* released a report identifying aircraft exhaust noise as a major problem that requires immediate attention.

Under this proposal, FSU proposes a comprehensive program with the short- and long-term goals of a) developing jet noise suppression technologies that can be retrofitted in the current aircraft fleet; b) undertaking a sustained research effort to better understanding the jet noise sources and fundamentals which will lead to the development of reduction capacities; and c) to improve noise suppression technologies that will become an integral part of the propulsion systems in future aircraft.

This will be achieved by leveraging our significant and unique resources and expertise in the study of jet noise and control. Leveraging resources provided by this program by the State of Florida, FSU will make appropriate improvements to our test and diagnostic facilities to provide the needed fundamental understanding for controlling jet noise. We will use our considerable expertise in Active Flow and Noise Control to rapidly develop and test many of the promising

noise control concepts; maturing, then transitioning to the field, the most practical and promising ones. Our team has significant expertise in both the study and control of jet noise and collectively represents some of the best scientists and engineers presently working in this area. Given the interdisciplinary nature of this problem, we are ideally suited to making a notable impact in solving the jet noise suppression problem. We are asking for \$3,800,000 to initiate this vital program.

Our final project involves Nanotubes Optimized for Lightweight Exceptional Strength (NOLES) Composite Materials. The U.S. Army's objective of developing effective personnel protection and a lighter, stronger fleet of fighting vehicles may be achieved through the diminutive nanotubes that 1) are the strongest fiber known, 2) have a thermal conductivity two times higher than pure diamond, and 3) have unique electrical conductivity properties and an ultra-high current carrying capacity. For producing lightweight multifunctional composites, resins impregnated with nanotubes hold the promise of creating structures, which will be the strongest ever known, and hence offer maximum personnel and vehicle protection. Benefits are apparent not only to defense, but also throughout the commercial world.

Partnered with the Army Research Laboratory, FSU's team of multi-disciplinary faculty and students has developed unique design, characterization and rapid prototyping capabilities in the field of nano-composite research, leading to vital defense applications. The NOLES research team is developing high performance thermal management materials utilizing nanotubes. The NOLES team is using nanotube composites for shielding against electromagnetic interference. Also, FSU's composites are being tested for missile wings, UAVs and missile guidance systems by various defense contractors.

Three core programs are envisioned for FY2011: 1) innovative lightweight personnel protection based on integrating cutting-edge technology and commercially available, proven materials for enhanced safety and security of war fighters; 2) developing nanotubes as a material platform and supporting manufacturing processes for a new generation of devices and structures, giving special attention to the design and demonstration for Army and defense applications; and 3) utilizing nanotube buckypaper and optically transparent nanotube thin films initially for liquid crystal display backlighting and eventually for flexible displays. We are seeking \$4,500,000 to continue this program in FY 2011.

Mr. Chairman, we believe this research is vitally important to our country and would greatly appreciate your support.