

STATEMENT OF

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Introduction. Mr. Chairman and members of the committee, on behalf of Rear Admiral Patrick Dunne, the Superintendent of the Naval Postgraduate School, I appreciate the opportunity to talk about the Naval Postgraduate School's continuing role in the education of America's space cadre. I am honored to be a Naval Astronaut and graduate of the Naval Postgraduate School (NPS), and I am the first of the 33 astronaut alumni of NPS to return as an instructor in the space systems curriculum. I also serve as the Associate Dean of the Graduate School of Engineering and Applied Sciences.

The Naval Postgraduate School exists to increase the combat effectiveness of the Armed Forces by providing graduate-educated members of the Officer Corps, including the Space Cadre. High quality graduate education requires students to be knowledgeable at the cutting edge of their area, which in turn requires an active and innovative research program for students and faculty.

Background. The Space Systems Academic Group (SSAG) at the Naval Postgraduate School was established in October 1982 under sponsorship of the Navy Space Systems Division in response to the Department of Defense's (DoD) increasing dependence on space systems in support of military operations. This interdisciplinary group – comprised of faculty from traditional academic departments such as physics and engineering, and chair professors – oversees content and delivery of the two Space Systems curricula: Space Systems Engineering and Space Systems Operations. In the past 20 years, we have graduated over 560 Navy, Marine, Army, and Air Force officers in these two tracks; and

our graduates are currently spread throughout the entire spectrum of organizations in our nation's space community – military, intelligence, civil and commercial.

The Navy's space focus has always been grounded in the operational use of space. The 1950's saw the Navy bouncing signals off of the moon for communication; and, the next decade brought the Transit navigation system for Polaris submarines and the Galactic Radiation and Background (GRAB) system – the nation's first space-based electronic intelligence program. The Naval Postgraduate School Space Systems program has evolved from this heritage.

Many early Navy space programs were conceived, designed, developed, launched and operated by a relatively small, integrated group. The NPS Space Systems program has retained this end-to-end, systems engineering approach; beginning with a clear understanding of the end-user requirements, and finishing with the satisfaction of those requirements. As doctrine has evolved to its current transformational and information-centric state, our program has expanded to view the operational use of space across systems boundaries to integrated systems architectures.

Faculty and Chairs. NPS recognized early the need to bring a multi-service, multi-agency approach to space education. This led to the establishment of six Chair professorships sponsored by the National Reconnaissance Office (NRO), National Aeronautics & Space Administration (NASA), Navy Tactical Exploitation of National Capabilities (TENCAP), Navy Space Technology Program, Naval Network and Space

Operations Command, and Lockheed-Martin. In addition, the MASINT Chair Professor supports the SSAG in areas of Measurement and Signature Intelligence (MASINT). The SSAG also includes a USAF military instructor and astronaut-in-residence. These diverse participants with real world experience and expertise provide an invaluable resource for our Joint student body.

Systems Approach. The current state of graduate space education at NPS is one of breadth and depth. Through support of the related academic departments and the academic chair professors, NPS offers a Space Systems Engineering curriculum and a Space Systems Operations curriculum. Both curricula lay a foundation in the technical disciplines required for insight into space systems – the Space Systems Engineering curriculum focusing on an engineering discipline and the Space Systems Operations curriculum focusing on systems architecture and mission design and operations planning. The Space Systems Operations and Space Systems Engineering curricula are both designed to cover the “cradle-to-grave” spectrum of space systems:

- Requirements
- Science and Technology / Research and Development (S&T/R&D)
- Acquisition
- Operations

The students in both curricula share many courses, but the Space Systems Engineering students concentrate more on S&T/R&D and Acquisition, and the Space Systems Operations students concentrate more on Requirements and Operations. This systems engineering approach, with different relative weights for each curricula, provides a

synergistic “big picture” lacking in most “specialization” type programs. Within the Space Systems Engineering curriculum, elective sequences allow the students to focus on the advanced disciplinary content from other departments, such as physics, electrical engineering, astronautics and mechanical engineering, which are required for excellence in systems engineering of space systems. Master’s degree programs in Electrical, Astronautical, and Mechanical Engineering are accredited by the Accreditation Board for Engineering and Technology (ABET).

Curricula Content. The curricula and corresponding courses are built according to Educational Skill Requirements (educational competencies), accreditation considerations and through regular curriculum reviews performed by our senior leaders, including the Chief of Naval Operations N61 staff, Naval Network Warfare Command staff, Space and Naval Warfare Systems Command, and the NRO. These reviews ensure the content and focus of the program keep pace with a continuously changing world. Both curricula include an experience tour to gain familiarity with a majority of the National Security Space elements (including various USAF Space Command sites, Navy space sites, NRO, Central Intelligence Agency, National Security Agency, and NASA).

Capstone Courses. Both curricula include course sequences that culminate in a group capstone project. Space Systems Operations students complete a sequence in space architecture, and the Space Systems Engineering students complete a sequence in spacecraft design. Representatives from industry and National Security Space (NSS) activities attend the preliminary and final reviews of these projects. Quite often, the

project is based upon a request from a customer, such as the NRO. For example, recent capstone projects have focused on real-world Transformational Communications and Space Based Radar system requirements.

Relevant Research. AT NPS, our students have the opportunity to take courses and perform research at the highest classification levels or pursue hands-on research building spacecraft, such as the PANSAT (Petite Amateur Navy Satellite) spacecraft built at NPS and launched in 1998 from the space shuttle “Discovery”. This practical, hands-on experience provides significant benefit in space acquisition management jobs after graduation. Many organizations interested in National Security Space have developed educational and research relationships with NPS. Our lab facilities are a model of cooperative efforts with the NRO, Naval Research Labs, the Air Force Research Labs and others. Just this year, NPS was awarded research contracts totaling over \$2 million for space-related research.

Distance Learning. The first NPS graduate course developed for the web was “Space Technology and Applications”. The addition of three more web-based courses led to a space certification educational program taught using the latest technologies in distance learning. Through this program, we are able to provide space education to military members worldwide. This four-course sequence provides the foundation to understanding the integration of space capabilities across combined arms forces, involving networks, sensors, and weapons. Completion of these sequences could possibly shorten a student’s stay at an NPS in-residence program.

Collaboration. The Air Force Institute of Technology (AFIT) and NPS alliance led to the formation of a Joint Space Academic Group (JSAG), which is comprised of faculty from AFIT and NPS, and includes another member representing the NSS user community. Initially, the charter of this group was limited to AFIT/NPS collaboration, but we realize that the charter should and will expand to include other institutions such as the USAF Space Operations School National Security Space Institute (NSSI) and other civilian institutions offering graduate-level space education. Accordingly, we also see the membership of the JSAG expanding. One of our goals is to develop a matrix of common Educational Skill Requirements or competencies for graduate space education, which would be part of the total list of competencies for the Space Professional. This will eventually allow flexibility so that the Space Professional Team can offer the right graduate education, for the right person, at the right time, for the right job.

Summary. Our mature curricula, interdisciplinary faculty, chair professors, long-standing organizational relationships and systems engineering approach all ensure that our graduates have a strong technical foundation, understand the operational use of space and are prepared to fill our nations most critical space positions.

In closing, I wish to thank the committee for your on-going support to our nation's security, to our nation's space programs, and to all of us in uniform. The Naval Postgraduate School stands ready and able to immediately execute space education

programs deemed necessary by this committee and our military leadership. Thank you for your time.