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INTEGRATION OF A HIGH ENERGY LASER INTO THE VIRGINIA CLASS SUBMARINE

by

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EXECUTIVE SUMMARY

Project Summary: A combat systems engineering approach was taken to determine the viability of integrating a high energy laser weapon system on a submarine. Several research, capstone and thesis efforts provided valuable insight and enhance the process going forward.

Background: The Division of Undersea Warfare (OPNAV N97) wants to investigate the feasibility of installing a HEL system on Virginia Class Submarine (VCS) BLK V platforms and beyond. Challenges common to all maritime platforms are mitigating the effect of the ambient environment including sea state, atmospheric optical turbulence and atmospheric transmission. In addition, the system will require innovative design and implementation to operate effectively with other combat systems while also being properly integrated with other submarine systems. A key requirement will be the ability for the system to engage threats from the surface.

Findings and Conclusions (to include Process) : The following are steps in the combat systems engineering approach:

- Define the mission through user input, context definition, identification of constraints including propagation effects (e.g. atmospheric optical turbulence), concept of operations and scenario generation.
- Analyze the mission through mission functional/timeline analyses, generating a design reference mission, operations analyses and performance requirements definition.
- Establish or validate system level requirements through system functional and timeline analyses including functional allocation.
- Synthesize concepts by identifying alternatives, assessing technology, generation of schematic block diagrams and selection of major alternative system suites.
- Evaluate concepts through selection of measures of performance/effectiveness, trade studies, performance analyses, cost-effectiveness analyses and selection of preferred alternatives.
- Refine the concept architecture, integration concept, preliminary system layout and concept of operations with documentation of decisions.

Capstone and thesis efforts as well as underlying research in the area of context definition provided progress in the process outlined above.

The HELSUB Team of Distance Learning cohorts 311-124O, 311-124G and 311-133O completed Capstone on Integration of a High Energy Laser into a Future Class of Submarine (Distribution D). This project included combat systems activities at a top level through concept synthesis with three candidate concepts for integration.

LT Patrick Stone completed a more detailed mission definition and analysis in his thesis, Combat Systems Engineering Conceptualization of a High Energy Laser Weapon System on a Submarine (FOUO). The integration of a high energy laser weapon system

with a submarine was conceptualized through a parametric analysis to illustrate potential utility. A combat systems engineering process was undertaken to examine the added benefits that a laser weapon system may provide for two potential submarine operations.

Measurements of atmospheric optical turbulence over Lazer Bay on San Nicolas Island were conducted providing diurnal and seasonal data through approximately six months. Analysis indicates that prevailing conditions provide near maritime measurements along the propagation path. These measurements and analysis are ongoing including measurements at lower propagation path heights.

Associated thesis and capstones provided additional progress in several steps of the combat systems engineering process described above. These efforts have applicability in the effort to determine viability of a high energy laser weapon system on a submarine. One associated thesis effort was completed by Jeremy Shattuck with his development of a Virginia Class Submarine Situ Environmental Sensing System (SubSEnSS) (Distribution D). This SubSEnSS provides environmental information to the submarine to aid in operational decision making including assessment of conditions for possible high energy laser weapon systems employment.

Several associated capstones were completed by Distance Learning Cohort 311-133O. One of these was Distance Support In-Service Engineering for the High Energy Laser. This capstone assessed the feasibility and ownership cost savings in implementing a distance support framework tailored to the high energy laser weapon system. Another effort was Comprehensive System-Based Architecture for an Integrated High Energy Laser Test Bed. This capstone developed a conceptual architecture and requirements for testing and evaluating high energy laser weapon systems including those integrated into submarines. Finally the capstone, Increasing the Kill Effectiveness of a High Energy Laser (HEL) Combat System, assessed the capability of a kill assessment system to improve the efficiency of high energy laser weapon system employment.

Recommendations for Further Research: Additional analysis is needed to complete the combat systems engineering process from synthesis to full system realization into all of the potential benefits and unforeseen difficulties that a high energy laser may offer a submarine.