2008 Summary of Research Reports

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Project: Turbine Fuel Testing with Boron Nanoparticles
Sponsor: DARPA –NRL

Statement of Work:

DARPA/NRL-US Naval Academy – Turbine Fuel Testing with Boron Nanoparticles Martin Cerza, Mechanical Engineering, US Naval Academy Peter Jenkins, Mechanical Engineering, US Naval Academy Objectives Provide intermediate gas turbine testing on designed fuel for performance and emissions. Overview The Boron Fuel Testing Program at the U.S. Naval Academy will leverage the expertise of the faculty and the turbine research facilities to determine the performance of fuel enhanced with boron nano-particles. In preliminary experiments, JP-5 fuel will used to obtain the baseline performance of a small T-63 gas turbine. The boron enhanced fuel will then be tested and compared with the baseline fuel. The U.S. Naval Academy has significant infrastructure in- place for turbine engine testing and measurement, as well as a dedicated technical staff and faculty with many years of experimental engine work. The associated faculty has a strong interest in the development of alternative fuels and research experience in this area. In addition, the midshipmen at the Academy offer an extremely talented pool of student researchers. The most talented and interested mechanical engineering students participate in research and yield significant contributions. Experimental Program Year 1 An Allison Model 250 T63 Turboshaft engine (Figure 1) at the U.S. Naval Academy will be used to compare the operation of a turbine using conventional JP-5 fuel with a fuel containing boron nano-particles. The engine would be tested using these alternative fuels in the turbine with no modification at steady-state conditions. Performance and emissions of the engine will be measured at several load and speed conditions across a typical operational "map," providing a base of data for comparing the fuel types. Year 2 with a basic understanding of the performance of these fuels in the T-63 turboshaft engine on the two fuel types, further testing will shift from basic performance testing to individual parameter measurements with the addition of combustor and turbine temperatures and pressure measurements. These tests will then quantify the variation in properties such as turbine inlet temperatures, peak pressure, emissions and engine performance. Year 3 Software and hardware will be developed to modify stock commercial fuel injectors so that fuel mixes can be validated for commercial platforms. In addition, companion computer simulations and durability studies will be considered.