Nano-ceramic Coatings for VCS Main Propulsion Shafts Could Create Life-cycle Savings

**Status:** Technical Success

**PROBLEM / OBJECTIVE**

The inspections of in-service Virginia class submarine (VCS) main propulsion shafts have revealed noticeable grooving of the electro-slag strip (ESS) cladding on the propulsor bearing journal. The main objectives of this ManTech project were to (1) evaluate potential solution(s) to the observed bearing journal wear issues on the VCS main propulsion shafts, and (2) identify those solutions with a high likelihood of increasing the current shaft replacement cycle from 72 to no less than 96 months.

**ACCOMPLISHMENTS / PAYOFF**

**Process Improvement:**

The Navy Metalworking Center (NMC) designed and fabricated a shaft and bearing test stand that was capable of inducing wear and grooving. NMC used this test stand to evaluate several bearing / journal material combinations. After evaluating various methods for producing the Alloy 625 journals (cast, clad and nano-ceramic clad), the project team determined that the nano-ceramic clad journals had the lowest total wear and the shallowest grooves of all journals tested. In addition, the nano-ceramic coating, when applied to the clad shaft, demonstrated very good adherence and high damage tolerance.

**Implementation and Technology Transfer:**

This project’s results and recommendations, as well as other separate, coordinated Navy efforts, will be used by the Navy Shafting and Bearing Research and Development Integrated Product Team to formulate and execute appropriate actions to address the grooving observed on in-service VCS propulsor shafts. Results from this effort are also being leveraged by the Ohio Replacement Program.

**Expected Benefits and Warfighter Impact:**

While it has not been qualitatively determined that a 96-month shaft replacement can be met, the results obtained during the project justify continued work in the use of nano-ceramic coatings for shafting applications as a means of meeting this objective. With this increase in the operational life of the shaft, life-cycle savings in terms of decreased maintenance availabilities will be achieved.

**TIME LINE / MILESTONE**

- **Start Date:** November 2010
- **End Date:** May 2014

**FUNDING**

- **Navy ManTech Investment:** $2.9M
- **Cost Share:** (PMS 450) $20K  
  (PMS 397) $900K

**PARTICIPANTS**

- PMS 450 (VCS Program Office)
- Naval Surface Warfare Center, Carderock Division
- Naval Sea Systems Command
- Electric Boat Corporation
- NMC
- ONR Navy ManTech

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