

Innovative Machining Techniques to Reduce Costs for VCS Propulsor Manufacturing

Status: Implemented

PROBLEM / OBJECTIVE

In an effort to reduce the total ownership cost of Virginia class submarines (VCS), the Navy has changed the propulsor material on Block IV hulls to Alloy 625, a nickel-based alloy that is highly corrosion resistant, but is very difficult to machine. To mitigate the anticipated cost and schedule impact, the Navy Metalworking Center (NMC) led an Integrated Project Team (IPT) to address the manufacturing challenges associated with machining these components. Specifically, the IPT investigated innovative machine tooling, alternative cooling technologies, and other machining process improvements.

ACCOMPLISHMENTS / PAYOFF

Process Improvement:

NMC developed small-scale test articles and a protocol that replicated the major regimes (weld cap removal, roughing, and finishing) encountered during production, and then performed an extensive test matrix to identify the optimal cutting insert and process parameters. The optimized tools and depth, speed, and feed parameters demonstrated effective material removal rates of two to three times those of the baseline processes, taking into account each tool life and tool change time. For example, the recommended weld removal and roughing inserts were run at a 0.100-inch depth of cut, compared to the baseline process 0.040-inch depth of cut. The selected processes were then demonstrated on a large-scale (88" diameter) test article at the production facility on a machine replicating the production machine. The project also investigated internal threading of Alloy 625, and demonstrated power tapping as a viable method, along with the potential cost and quality improvements.

Implementation and Technology Transfer:

Project implementation was targeted for VCS Block IV propulsor production. However, in April 2015, BAE Systems began implementation on Alloy 625 sections of Block III propulsor components. BAE has continued implementation with additional tooling for its new, large vertical boring mill. Internal threading of Alloy 625 will commence with Block IV production.

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S2548 Machining Alloy 625 Propulsor Components
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Machining improvements will save significant costs in the manufacture of VCS propulsors, which are now made of nickel-based Alloy 625. NMC photo

Expected Benefits and Warfighter Impact:

This project will improve the production rate and reduce the cost increase anticipated for production of Alloy 625 propulsors. Estimates to machine Alloy 625 are roughly three times the cost and duration of the present propulsor machined from HY steel. By implementing a more aggressive machining process, the project is expected to save at least \$6 million over a five-year period. By reducing this critical path process duration by an estimated 150 days, the project has substantially reduced the risk of late components, which would have delayed ship delivery and incurred program costs estimated at \$85,000 per day.

TIME LINE / MILESTONE

Start Date:	July 2013
End Date:	April 2015

FUNDING

Navy ManTech Investment:	\$1.3M
Cost Share: (BAE Systems)	\$50K

PARTICIPANTS

NAVSEA PMS 450
NSWCCD Code 6102
National Center for Defense Manufacturing and Machining
BAE Systems
NMC
ONR Navy ManTech