Department of the Navy SBIR/STTR Transition Program

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MCSC-PRR-3070

Topic # N162-079
Fuel Efficiency Improvements for Amphibious Vehicles
Pacific Engineering, Inc

WHO

SYSCOM: MARCOR

Sponsoring Program: PEO Land Systems

Transition Target: ACV 1.1

TPOC:
sbir.admin@usmc.mil

Other transition opportunities:
US Army Tank-automotive Command (TACOM)

US Army Field Artillery School

https://www.marines.mil/News/News-Display/Article/1555187

Notes:
PEI light weight, corrosion resistant composite technology for ACV 1.1 will reduce the vehicle weight which will improve its survivability due to decreased fuel consumption and increased speed and maneuverability in the water, while also reducing costs due to corrosion. Advanced composite material advantages over metallic are: a) Higher strength to weight ratio, b) Higher specific stiffness, c) Increased fatigue life, d) Low thermal expansion, and e) Superior corrosion resistance. The technology will be transitioned into ACV 1.1 components. All composite structure design and fabrication efforts are performed at our 34,500 square-foot development and production facility south of Lincoln, Nebraska. This site contains state-of-the-art equipment and tooling for designing, manufacturing and testing composite structures, whether it be filament winding, resin infusion, or compression molding.

WHAT

Operational Need and Improvement: The U.S. Marine Corps is looking for innovative technologies that reduce fuel consumption and enable longer mission durations for the Amphibious Combat Vehicle (ACV). The amphibious vehicles operate on the leading edge of an assault and in environments where ongoing access to fuel is limited and operate in harsh in-water and off-road environments. Solutions that reduce weight, particularly un-sprung mass, can improve fuel efficiency while also improving ride quality and water performance. More efficient fuel usage will also enable longer mission durations and increased operating ranges. The goal for this program is to reduce fuel usage over the mission profile by 10 to 15%.

Specifications Required: The goal for this program is to reduce fuel usage over the ACV mission profile by 10 to 15%. The ACV will operate on land for more than 95% of its mission and, despite averaging over 60% of its time at idle, under low load or silent watch, the majority of its fuel usage is expected while the vehicle is moving. The land operating profile is expected to consist of 10% primary roads, 20% secondary roads, 30% trails, and 40% cross country. The weight savings will yield a sizeable reduction in vehicle weight decreasing fuel consumption and increase operational performance in the water and on land.

Technology Developed: Using composite materials for the design and fabrication of “selected” parts/structures can provide desirable benefits beyond just saving weight. Composite parts/structures show the most benefit in applications which operate in extreme environments (high stresses, fatigue, multi-axial loading, high/low temperatures, corrosive environments, etc.). Composite materials are inherently corrosion resistant, and since an amphibious vehicle will be exposed to variety of corrosive environments (sea and land), the use of composites can mitigate costly restoration and or replacement due to failure.

Warfighter Value: Increased fuel savings of the ACV 1.1, resulting from weight reduction, is critically important to the operational success of the mission. Improved in-water speed. Increased corrosion control would provide an increase in operating hours and reduced maintenance time. Composites using fiberglass can offer as much as 40-50% weight savings over steel while carbon fiber composites can yield weight savings as much as 70%. Composite torsion bars, which decrease maintenance downtime and reduce weight, can be introduced into the production schedule and retrofitted to fielded vehicles. Other composite components can be introduced during production.

WHEN

Contract Number: M67854-18-C-6527 **Ending on:** March 23, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Parts/assemblies recommendations for conversion to composite construction	Med	Recommendation concurrence from ACV Prime contractor	5	1st QTR FY20
Torsion Bar Prototype Fabrication	Med	Prototype meets inspection requirements	5	2nd QTR FY20
Torsion Bar Prototype Testing	Med	Prototype meets performance requirements	5	3rd QTR FY20
Torsion Bar Production Qualification Testing	Low	Completion of all product quaification requirements	5	1st QTR FY21
Torsion Bar Production	Low	FRP Contract Award	7	2nd QTR FY21

HOW

Projected Business Model: All composite fabrication, whether it be filament winding, resin infusion, or compression molding is performed by PEI within our 34,500 square-foot development and production facility south of Lincoln, Nebraska. This site contains state-of-the-art equipment and tooling for designing, manufacturing and testing composite structures. Recent upgrades to the computer control systems provides high precision Programmable Motion Control Systems used on advanced robotic machines. The filament winding capability is supported by two filament winding machines. Based on the planned production rate of the ACV 1.1, PEI has the capacity to fabricate the components developed under this SBIR project. PEI received technical data associated with ACV 1.1 production and testing program plans.

Company Objectives: PEI has begun exploring transition pathways for the composite technology and components developed under this SBIR project. PEI has contacted and met with the AAA Program Office. The Survivability Engineer has sent PEI technical data that has identified specific design details, including issues that are related to the weight, water performance and survivability. PEI has met with the ACV 1.1 prime manufacturer BAE. Technical exchanges relating to potential application of composites are ongoing with prioritization of each. We are discussing pathways into a draft transition plan. PEI has successfully transitioned the Ready Stow Group (RSG) Launcher and Anti-Torpedo Torpedo All-Up Round Equipment (AURE) canister to fleet CVN’s and since 2012 have seen multiple carrier deployments.

Potential Commercial Applications: Composite structures can provide huge benefits because of their significant specific weight and stiffness improvements as compared to metals. The single most important structural advantage for composites is realized by orienting the fibers/plies in the direction(s) of the applied loads. There are four main direct loads that the composite material must withstand: tension, compression, shear and flexure. The response of a composite to tensile loads is very dependent on the tensile properties of the reinforcement fibers; whereas, the resin plays the major role when a composite is under compressive, shear and flexure loads. Composite structures must connect or attach to other metal structures or features which necessitates a thorough understanding of joint design and manufacturing processes.

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