Affordable ManTech for Future Combat Systems (FCS) Structural and Appliqué Armor

Provides automated manufacturing technology solutions for critically needed armor structural subassemblies, armor ceramics, metallics and composites, and appliqués.

OBJECTIVE / SOLUTION

Advanced manufacturing technologies for armor systems, both structural and appliqué, are critical for the development of Future Combat Systems (FCS). The high cost to fabricate and long lead times for integrated materials can result in missing cost targets or production schedules. Since the beginning of the program, weight has been driving many program decisions. Recently it was decided that the FCS-Manned Ground Vehicle (MGV) concept calls for an "A" hull structure and modular "B" appliqué armor to achieve full combat configuration (FCC). The use of appliqué will also facilitate tailoring the armor to a particular tactical situation and allow improved armor technology to spiral in from the baseline B1 to an improved B2, B3, and BX armor over a short period of time. These decisions have validated the approach being taken within the Armor ATO-M program for the past several years to develop underlying generic technologies that form the foundation for any specific solutions being developed by the design community. Subassembly processes will be automated and streamlined. Structural assembly and processing stream will be optimized to support all appliqué armor and other appurtenances. Subassembly processes will be integrated to produce test and qualification articles as part of the transition process to the FCS vehicle integrators.

Future Combat Systems (FCS) Command and Control Vehicle

Structural and Appliqué Armor

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ACHIEVEMENTS

During FY03-FY06, structural and appliqué armor processing technologies were benchmarked; critical areas for improvement of cycle time and material availability were identified; cost reduction efforts were initiated for advanced armor-grade SiC-N ceramic and titanium; model centric manufacturing practices for vehicle integration demonstrated; and, preform and tile joining to metallic and composite armor structure in a manufacturing environment demonstrated. The cost of SiC tiles has been reduced from $135/lb. to $85/lb.

BENEFITS

- Provides lighter weight, survivable platforms with light, affordable armor that meets FCS ORD requirements.
- Reduces cycle time and cost of manufacturing by 25-40%.
- Reduces structural armor processing time by 50%.
- Improves ballistic performance by 10%.
- Manufacturing technology transitions to vehicle integrators for production in FY06 through FY09.

STATUS

- **Model Centric Systems for Design/Manufacture of FCS Structure—**The Team has been successful in creating a modeling and simulation environment where CAD information from Pro-E, being used by the FCS Vehicle Integrators, can move in and out of the Production Processes Resource (PPR) hub and interact with Delmia CAM tools. Changes can then flow back through the PPR hub to implement design modifications. Current efforts are focused on: (1) moving manufacturing and design data (notes, symbols, dimensions/tolerances, surface finish specs, datums, etc.) easily through the hub with minimal manual oversight/entry, and (2) establishing 3D images in layered views to present descriptive data in an easily understood view rather than on a single layer, making it unintelligible.
- **Advanced MGV Structures Manufacturing (Ceramic/Composite Armor)—**The laboratory process for making armor is being carefully studied to determine if all steps are necessary to maintain current performance. The current goal of the program is to reduce costs by making the ceramic facial upper half of the armor system using an automated process rather than current labor intensive manual processes. Production methods of manufacturing, including prepreg or, where applicable, vacuum-assisted resin transfer molding (VARTM), rapid lay-up tooling, and adhesive bonding, have been applied to emerging B armor formulations. Plans are in place to manufacture actual FCS maturation structures using the developed technologies.
- **PAD SiC-N Ceramic Tile Processing—**Third year funding has been awarded to continue efforts to develop a state-of-the-art semi-continuous production line for rapid hot pressing of SiC-N tiles. The prototype line is now operational and a campaign run of qualification tiles is being produced. Two high speed precision grinders are now on line and will significantly reduce grinding cost, which is the single largest cost of producing tiles with current manufacturing practices. Cost of tiles should be reduced to $85/lb. by the beginning of FY07 and to $50/lb. by the beginning of FY08.
- **Low Cost Titanium Components for Armor Applications—**Various titanium powders were evaluated by ADMA for the direct powder rolling (DPR) of titanium alloy armor plates. Fully dense Ti-6A1-4V strips were produced by a low cost DPR process followed by a sintering operation. A 24" wide refurbished rolling mill is on order for December delivery. Modeling results show that this mill should be capable of producing 0.300" thick green plate. Ingot size slabs have been produced by cold isostatic pressing followed by sintering in the new vacuum furnace. Slabs are then reduced to plate using a traditional rolling mill. Plans are underway to ballistically test this plate by the end of FY06.

WEAPON SYSTEMS / SECONDARY ITEMS IMPACTED

- All Future Combat Systems Mounted Combat System (FCS MCS)
- Ballistic protection for FCS Science and Technology Objective (STO)
- Bradley M2A3 Infantry Fighting Vehicle
- PEO Soldier

POTENTIAL COST AVOIDANCE

- Reduction in engineering changes and material change board revisions of 25% through implementation of model-based design and manufacturing.
- Reduction in ceramic tile cost from $135/lb. to $35/lb.
- 30% reduction in cost and cycle time for procurement of Ti using solid state processing.