

*Bleeding Edge EnSys, LLC.*

Army Expeditionary Technology Search (xTechSearch) Competition  
**CONCEPT PAPER 7-10-2018**

Technology Focus Area:

**Next Generation Combat Vehicles**

Design / Advanced Power Generation

**Advanced Thermo-Aerodynamic Diesel/Electric Upgrade**

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## Proven Operating Principals

- Up to 10% fuel savings/lower emissions
- 65+ restored horsepower
- Improved engine environment
- 50% lower under-hood temp/thermal signature
- 50dB lower under-hood sound/acoustic signature
- Improved drag-coefficient
- Reduced heat-related failures
- Reduced maintenance cost/intervals

## Next Generation Combat Vehicle Technology Starts with Optimized Cooling and Airflow

Heavy-duty vehicles are challenged with higher-performance demands and higher under-hood temperatures. Military vehicles must optimize armor weight/insulation. Heavy trucks experience near constant heat-related component failures. EV/HEVs face similar challenges with reliable/efficient cooling of batteries/motors/brakes, especially with high-voltage/rapid-charging.

Our technology is a fundamental shift in vehicle cooling system design. The globally patented advanced thermo-aerodynamic AMS (Air Management System) optimizes internal combustion engines (ICE) by dramatically improving airflow/cooling/engine power. This innovative and overlooked solution solves critical problems facing heavy-duty vehicle design and maintenance/operation by reconfiguring the under-hood airflow.

The AMS redirects hot radiator air to outside the vehicle reducing under-hood temperatures up to 50%. High-performance electric fans restore 65+ horsepower to the engine by removing parasitic loads of the original belt/gear-driven fan assembly. Custom internal/external ducting separates radiator air from the engine compartment. All incoming air is efficiently diverted through the plenum/hood eliminating “dead-heading” and improving drag-coefficient. The engine and compartment split cool ram-air coming in through a full-width cowl-induction scoop. Heated compartment air exits through pressurized side ducting. The AMS creates fuel savings with minimal engine/body modifications. The TMC/SAE J1321 Fuel Economy Test conducted by Claude Travis & Associates resulted in an average 7.47% fuel savings on a fully loaded Class 8. Ryder Systems tested 2 on-road trucks. New modifications are estimated to increase savings to 10%. Wind tunnel testing conducted by Jacobs Engineering at Ford Motor Company revealed 130°F reduction in under-hood temperature. The system weight and cost is similar to replaced OEM parts. A version of the AMS has been tested on a military Humvee in simulated environments and our current Class 8 truck is a 3<sup>rd</sup> generation prototype with the production model in development. The AMS also has potential to cool motors/batteries/breaks.

In addition to the AMS, a synergistic set of proprietary cooling system cleaner/inhibitor filters are used to fully clean/restore scaled-out cooling systems and keep them clean with non-acidic chemistry that doesn't damage aluminum/copper, while driving. Direct benefits realized in a nine-year independent study confirm dramatic decrease in maintenance costs and failures/replacements of radiators, water pumps, defroster cores, oil coolers, hydrostatic fan controls, lines, and 100% reduction of clog related overheats.

This total air/liquid cooling system protection removes all general heat related risks to the vehicle.

Using natural principals, optimized controls and redesigned under-hood airflow, next generation vehicles will see immediate improvement in temperature reduction, increased available horsepower, fuel savings and drivability improvement from lower noise level. This technology is suitable for any ICE or EV/HEV experiencing high demand workloads and/or long idles times, especially heavy military vehicles in hotter climates. We are developing an

advanced telematics package that collects all critical vehicle system data and will directly verify efficiency and operational claims.

The next phase of development is to build an advanced diesel/electric hybrid module integrated into the AMS to further optimize performance. The AMS will benefit HEVs with cooling and restored horsepower, allowing a lower HP engine to be used in an HEV design while maintaining the same power output and MPG.

We are in development on this custom regenerative electric drive upgrade for heavy commercial trucks allowing full EV low speed driving, seamless EV-to-Diesel transition and back, fast charging while driving and overall increased range with lower fuel consumption. The HEV concept electrifies all accessories, serving as an advanced APU for the ICE allowing full EV-idle, increased horsepower, less maintenance/downtime and increased vehicle life. We anticipate the new design to provide a high-torque/full EV operation with zero-emissions/fuel for low-speed driving and seamlessly transition to an optimized diesel engine for highway cruising and recharging. Additional benefits include redundant propulsion and fewer engine failures/recovery costs. The HEV module is estimated to create up to 30% fuel savings with the total combined AMS/HEV system close to 40%+ savings. Restoring HP to the engine allows for down-speeding the ICE or spec'ing lower horsepower. This can result in significant light-weighting, and smaller fuel tanks while maintaining or increasing MPG/range.

Commercial and military vehicles need proven/rugged/reliable equipment with lower operational costs. The AMS Thermo-Aerodynamic Package is TRL 7. The AMS finalized commercial ready system will be completed early 2019. The Cooling System Cleaner Filter is TRL 9, commercially available, and proven with a nine-year independent case study. The HEV System is TRL 2/3 though all its independent parts are TRL 9 and commercially available. We are currently in R&D phase 1 with a leading electric vehicle controls company and seeking additional funding to build an HEV around the AMS. The Hybrid Prototype is on our road map in less than 2 years through rapid development and testing.

#### **Core Team Members & Primary Experience**

- **George Sturmon**, Inventor/Owner/Engineer, founder of ATRO, a leading manufacturer of high-performance polymers for high-wear, high-heat, shock/vibration-mitigation. Work in proprietary chemistry for anti-blast/ballistic polymers and composites. Published works in thermodynamic management/gaseous fuels, worked on Gemini reentry issues, has 50+ global patents.
- **Edward Murray**, Vehicle Technician, co-inventor and military technician on AMS for early Humvee trials.
- **Susan Schmidt**, Vice President/Manufacturing/Purchasing, vast knowledge of purchasing/sourcing manufacturing processes, taking product R&D to market/starting new companies.
- **Mark O'Hare**, Business and Technical Advisor, 18-year CEO experience and retired USN CAPTAIN (PEO) with numerous successful government/commercial production and product deployments in hardware, software, IT and Cyber Security products, has run multi-million/billion-dollar businesses, is technically astute with 300+ global patents.
- **Joshua Medling**, Creative Director/R&D, research/product dev and strategic marketing, won 1<sup>st</sup> Place Award for the AMS submission to NASA/SAE Tech Briefs Create the Future Design Contest 2017.
- **Glenn Harris**, Plant & Quality Manager, uses ISO9000/Mil-Spec procedures for quality-control, extensive manufacturing/machining/automation/inspection knowledge.
- **Jason Harmon**, Heavy Truck Mechanic/Technical Advisor, successful truck-shop owner, has extensive knowledge of truck subsystems/industry.