

Energy Storage Manufacturing—High Power, High Energy Density Lithium Ion (Li-Ion) Batteries

Implement automated manufacturing processing to reduce production costs while improving overall battery performance, safety, and reliability.

OBJECTIVE / SOLUTION

This ATO-M is designed to improve the existing limited manufacturing capability for high power 30Amp/hr battery cells by automating selected manufacturing processes. The goal is to increase the production rate and yield of battery cells and to reduce production costs while improving overall battery performance, safety, and reliability. Target metrics of the program include: reducing the cost of the 30KW-hr battery pack from \$115K to \$58K, increasing power density from 1KW/kg to 3KW/kg, and increasing energy density from 105W-hr/kg to 150W-hr/kg. Technology improvements will include new electrolyte and electrode materials that will enhance high temperature stability. New built-in circuit breaker technology will also be evaluated to reduce the risk of overcharging and venting. Development of prismatic lithium ion cells optimized for an integrated cooling system will be investigated.

ACHIEVEMENTS

Project scope includes 880 tasks over six years which include: manufacture of improved electrodes, cell closure and bussing/circuit breaker, cell filling, cell formation, battery assembly, performance and safety, and liquid cooled module and prismatic cell development. Process definition and process design trials have been completed and long lead equipment has been delivered. Technology investments in joint TARDEC/ARL tasks for developing new fire retardant electrolyte and thin electrode materials to increase cell power density are being executed in parallel with this ATO-M. One major achievement is the improvement of the cell (a 14% improvement in energy density, an 11% improvement in weight, a 75% improvement in power density, and a 63% reduction in the cell labor hours). In addition, the cell improvement has been applied to another cell for improved power and energy density. New Lithium Iron Phosphate cells and modules have been built through the ManTech Program for enhanced safety. Production factory flow has been reduced by 50% and a 50% cost reduction at the cell level has been realized. Work is continuing on improving the performance at lower temperatures by introducing additives to the electrolyte, novel anode research, and focusing on the plan to improve battery assembly and module interconnections.



Improved Targeted Acquisition System for the TOW Missile



SAFT Battery Module

BENEFITS

- Affordable high power and high energy density Li-Ion batteries suitable for traction
- Expansion of Silent Watch and Silent Mobility capabilities for future tactical and combat fleets
- Additional boost power for dash mobility and acceleration with a positive impact on survivability
- An automated Li-Ion battery manufacturing process within the US
- Reduction of the battery pack cost by half its current cost

STATUS

- Project plans and execution for long lead equipment and process design to meet ATO-M objectives are in process
- Circuit breaker design verification is in progress; current tabless bussing approach has been selected and new tooling is being developed
- Process and fundamental studies for cell filling including electrode porosity, separator porosity, and cell porosity have been completed. Testing of new formation procedure and equipment purchase for formation and filling is ongoing
- Fundamental electrochemical research to improve cell performance and safety is ongoing in the areas of electrolytes, separators cathode and anode materials are also being considered for less energetic reactions under overcharge

WEAPON SYSTEMS / SECONDARY ITEMS IMPACTED

- Manned and Unmanned Ground Combat Vehicles (MGCV/UGCV)
- Future Tactical and Ground Combat Fleets

POTENTIAL COST AVOIDANCE

- Return on Investment of 5.6:1 with a cost benefit of \$121M