OBJECTIVE: The objective of this effort is to investigate, develop, and fabricate a scalable, modular, highly energy dense, smart battery solution set comprised of an energy storage source (6T format) with an embedded battery manager and inverter subsystem. Successful execution of this effort will result in benchmark reliability and operational flexibility characteristics critical to Soldier, robotic enablers, and remote system (weapons and communications) applications in support of Soldier Lethality, Network, and Next Generation Combat Vehicle (NGCV) CFTs.

DESCRIPTION: To ensure successful outcomes in the tactical battlespace, all operations require the capability of, and reliability from, electrical power. Therefore, to enable and support the initial phases of offensive and defensive tasks, Soldiers typically use a hybrid power/energy configuration comprised of portable batteries, renewable power supplies, low-voltage generator sets, and the associated hardware to support electro-mechanical interfaces. While a viable approach, it is not always practical in terms of the operational compatibility of a given battery chemistry within varying tactical environments, of the functional interfaces between the battery and inverter, and of Soldier carry, mobility, and ease of use. Commonly available low-voltage COTS batteries may not be immediately suitable for use in certain tactical environments or applications. Energy inefficiency, parasitic power loss, and thermal management issues can arise if the power electronic inverters, battery management system, and selected battery chemistry are incompatible. Finally available COTS inverters are not designed to handle the impact of nonlinear loads and are many times too large and heavy for tactical applications.

To take advantage of a true hybrid power and energy solution, the Army seeks a Soldier portable (lift/carry) smart battery with an embedded battery manager and inverter subsystem for tactical applications in a multi-domain operating space. Solutions sought shall be modular and scalable to support operations requiring 2 to 5 kW. Final results shall enable a less complex system configuration with minimal to no interface hardware.

PHASE I: Develop conceptual component, subsystem, and system-level scalable (2 – 5 kW) / modular smart battery with embedded inverter and battery manager design in accordance with the following metrics. Battery: • COTS Li Ion – 6T format • 24 V module w/programmable DC or AC output Embedded Inverter: • Scalable serial connection: 24 V increments • Parallel connection: to enable multiple battery • Variable DC voltage: 3.6 - 48 VDC • Fixed AC: 1-Phase: 120 VAC • Fixed AC: 3-Phase – 120/208 VAC • Variable AC frequency: 50 and 60 switch selectable Battery Management: Cell-level voltage, cell temp, and SoC monitoring; module/string voltage and current; failure isolation Communication Interface: ModBUS TCP/IP; CANbus with progression to TMS as it becomes available

Transport: Ability to be safely transported by commercial and military vehicles and aircraft Results of Phase I shall support battery selection and its integration with the appropriate battery management system and inverter circuitry to realize a scalable, modular hybrid intelligent battery system design for execution in Phase II. Phase I discussions and design should include the following elements: a. Narrative and graphical depiction of the design b. Projected physical attributes c. Projected performance metrics d. Identification of the Technology Readiness Level of the technology

PHASE II: Design and develop a fully integrated proof-of-concept Energy Storage System with an Embedded Battery Management and Inverter Subsystem based on the Phase I results. Integrate and demonstrate operation and function with the Army 2 kW GenSet. Conduct operational/functional tests to confirm performance. Provide an interface design to support the subsequent scaling to outputs commensurate with integration/interface onto Soldier, robotic enablers, and remote weapon/communication platforms.

PHASE III DUAL-USE APPLICATIONS: Finalize development of a modular Energy Storage System with an Embedded Battery Management and Inverter Subsystem. Identify target markets for the system and an industry partner for production of the system. Determine feasibility of teaming with a battery OEM (original equipment manufacturer) for development of an Advanced Technology Demonstrator. Develop partnerships with individual companies and Platform PMs (such as PM-E2S2 and PM-SWAR) for rapid fielding of results into the STEP procurement effort by FY25 and the Network and NGCV demonstrations for FY24.

REFERENCES:

39th Chief of Staff of the Army’s Modernization Priorities #1


5. MIL-HDBK-454 - Standard General Requirements for Electronic Equipment