Preliminary Statement of Need

Solution of Interest Statement: Zero-Volt Tolerant Fast Charging battery (>10C to 90% SOC)

Sub-Title: Zero-Volt Tolerant Fast Charging – Energy Storage Technologies

Technical Areas:

- Verification and Validation
- Materials and Processes
- Manufacturing Technology
- Power and Energy Systems

Background & Problem Statement:

Applications with Uncrewed Aerial Vehicles (UAVs) need energy storage batteries that can be charged quickly in 5 minutes or less and is zero-volt tolerant to allow swarms to use the same charger in expeditionary missions. The ability for the energy storage technology to repeatedly survive discharge to zero volts eases energy storage management control and can be used like a capacitor in hybrid energy storage systems for remote and autonomous applications.

Current State of Technology:

Most Li-ion battery cells operate in a voltage window of 2.5V to 4.2V and a temperature window -10°C to 50°C for discharge and 5°C to 45°C for charge. Discharging below the minimum voltage degrades performance resulting in irreversible damage and charging above the maximum voltage causes electrolyte breakdown and failure. Battery packs contain battery management systems (BMSs) to maintain proper operation within voltage and temperature windows.

Zero-volt (cells capable of being fully discharged to 0 volts without damage) energy storage technologies have been developed, for example, by Enersys (Quallion) for only medical applications and also by American Lithium Energy (ALE) for medical applications. For defense applications, cylindrical and prismatic cells are preferred over pouch cell formats due to their robustness. Fast charging cell technologies have also been developed, for example, Nyobolt (UK) has developed fast-charging niobium (Nb) technology. Battery Streak, Purdue University, and ALE are also developing fast-charge niobium Li-ion technology but more research needs to be done.

Success Criteria:

a. Charge and discharge current: up to the 12C-rate or higher with 90% of rated capacity (Ah) retained
b. Energy density: >250 Wh/kg
c. Power density: >240 W/kg
d. Operating temperature (charge & discharge): -30°C to 60°C
e. Cycle life: 300 cycles at -20°C at 8C-rate charging at full depth of discharge at C rate to 80% of rated capacity (Ah)
f. Cell format and capacity: Cylindrical 18650 or 21700, or pouch cell, with rated capacity of >2.5 Ah at 25°C

g. Number of Prototypes: five (5) minimum, delivered to NSWC Crane for evaluation

Total Estimated Project Value: Award amounts will vary based on proposed solution and funds available (approximately $300K and above).

The above value is the total estimated budget for all focus areas across potential multiple awards.

Certainty of Funding: Funding availability is subject to Congressional appropriation of funding for Fiscal Year 2025 Defense budget. Note that all awards are subject to availability of funding and successful negotiation of an agreement.

Length of Project: Duration will be negotiated based on each proposal, up to 36 months.

Highest Security Classification Level: UNCLASSIFIED

Anticipated Data Rights: Government Purpose Rights

Foreign Company Participation Permitted: No