

**Expeditionary Missions Consortium – Crane (EMC<sup>2</sup>)  
Other Transaction Agreement**

**Preliminary Statement of Need**

**Solution of Interest Statement: Low Temperature Rechargeable batteries (down to -60C)  
Sub-Title: Wide Temperature Range ( $\pm 80^{\circ}\text{C}$ ) Energy Storage Development**

**Technical Areas:**

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

**Background & Problem Statement:**

Operational energy storage for long-term applications does not exist for extreme temperatures ( $-80^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$ ) often encountered in the Arctic, space, winter and desert environments. In expeditionary and remote terrestrial applications, the ability to warm or cool a battery may not be possible and is impossible for autonomous “field & forget” applications.

**Current State of Technology:**

Most rechargeable (secondary) battery cells operate in a voltage window of 2.5V - 4.2V and a temperature window  $-10^{\circ}\text{C}$  to  $50^{\circ}\text{C}$  for discharge and  $5^{\circ}\text{C}$  to  $45^{\circ}\text{C}$  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. Some batteries in the current market discharge at colder temperatures to  $-30^{\circ}\text{C}$  or even  $-40^{\circ}\text{C}$  with substantial capacity loss, but they must be charged at much warmer temperatures. For example, researchers at Purdue University have demonstrated 50% capacity retention on Li-NbWO coin cells at  $-100^{\circ}\text{C}$ .

**Success Criteria:**

- a. At  $-80^{\circ}\text{C}$ , 50% retention of rated capacity (Ah) at  $25^{\circ}\text{C}$  at 0.5C rate
- b. Energy density:  $\geq 300$  Wh/kg
- c. Operating temperature (charge & discharge):  $-80^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$
- d. Cycle life: 100 cycles at  $-60^{\circ}\text{C}$  and  $80^{\circ}\text{C}$  at full depth of discharge at C-rate to 80% or rated capacity (Ah) at the cycle temperature.
- e. Cell format and capacity: Cylindrical 18650 or 21700, or pouch cell,  $<2.5$  Ah at  $25^{\circ}\text{C}$
- f. 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