UNITED STATES ADVANCED BATTERY CONSORTIUM LLC

DEVELOPMENT OF ADVANCED LOW-COST / FAST-CHARGE (LC/FC) BATTERIES FOR ELECTRIC VEHICLE (EV) APPLICATIONS

REQUEST FOR PROPOSAL INFORMATION (RFPI)

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USABC DEVELOPMENT OF ADVANCED HIGH-PERFORMANCE BATTERIES FOR EV APPLICATIONS

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1.0 Statement of Purpose/Objectives

The United States Advanced Battery Consortium (USABC) was formed in 1991 to sponsor development of advanced high-performance batteries for Electric Vehicle (EV) applications. USABC has carried out a number of battery development programs, focusing on low-cost and long-life batteries with varying power-to-energy ratios. With this request, the USABC intends to re-engage development activity in the area of high energy to power ratio batteries, and specifically those which are low cost and have the ability to fast charge.

The purpose of this RFPI is to identify single developers or collaborative supplier-team developers having electrochemical energy storage technologies which have the capability of meeting or approaching the USABC commercialization criteria, as listed in the Appendix A which follows at the end of this document. The USABC expects that this work will be partially funded by the US Department of Energy through a cooperative agreement awarded to the USABC. Although project goals can be set that approach but not meet all of the USABC goals, a credible plan toward achieving all the USABC goals must be provided. The two most important goals for projects selected under this solicitation are cost and fast charge capability. These two categories will be weighted more heavily than other performance measures in the selection process. The goals are for development which will result in commercialization of the cells by CY 2023.

The USABC intends to capitalize on the knowledge it has gained through the HEV, PHEV, and EV research and development activities it has been engaged in. We expect developers to bring past experiences and lessons learned from their high power and/or high-energy electrochemical development work to bear on developing energy storage technologies for this application.

2.0 Business Objectives

This USABC RFPI represents a unique opportunity for developers to leverage their resources in combination with those of the automotive industry and the federal government. For the auto makers, this type of pre-competitive cooperation minimizes duplication of effort and risk of failure, and maximizes the benefits to the public of the government funds.

Beyond the efficient and timely usage of resources, the auto makers recognize that successful commercialization of these technologies will only be completed when the supplier base has been established for the selected components and subsystems. It is, therefore, a major business objective of USABC to enhance a supplier base as the development progresses. All developers submitting proposals will be required to demonstrate that they have the potential to develop a commercially viable business, which can produce sufficient volumes to meet automotive requirements, and provide engineering and testing support to meet automotive implementation

requirements. Research organizations with current, direct affiliations with businesses that derive a majority of their income from related product sales, will also be considered. At the time of submittal, all developers will be required to have demonstration hardware and test results available for USABC inspection. Testing performed in accordance with the USABC battery test procedures is preferred, however not mandatory. Inspection and test of hardware by the USABC may be included in the selection process. Developers who do not have hardware and test results available for inspection by USABC at the time of submittal need not respond.

3.0 Developmental Timing

The proposals must be accompanied by a development time chart characterizing the following:

1. Length of time the technology has been under development by the developer;
2. Length of time remaining to full scale, vehicle-size prototype hardware availability; and
3. Time line for commercialization, including any preproduction phases that may be planned.

4.0 Business Case

The submittal must be accompanied by a business case, divided into two sections. The first section shall state the cost assumptions used that will lead to the cost targets listed in Appendix A. These assumptions should be in general terms, broken down by major components, including material cost, processing cost and other costs. These costs should be presented in sufficient detail such that they can be used by the USABC to build confidence that its cost targets can be met by the technology.

The second portion of the business case is to address the anticipated capital investment required to support this initial program investment, including anticipated non-EV markets for the technology, sources of capital, etc. A copy of the USABC cost model, which is a multi-stage spreadsheet, is available on the USABC website, http://www.uscar.org/guest/article_view.php?articles_id=143. **USABC will not provide funding for capital expenses.**

5.0 Technical Challenges

Proposals must be accompanied by a clear description of the remaining technical challenges that the developer still needs to meet in order to commercialize the proposed technology and meet USABC's long-term criteria. A narration of the technical challenges that have already been met to reach the present state of the demonstration hardware will also be useful. Any testing, by USABC, of pre-contract demonstration hardware will be done in accordance with the USABC battery test procedures. These procedures can be found on the USABC website, http://www.uscar.org/guest/article_view.php?articles_id=86.

6.0 Information Requested

The information USABC is requesting from interested parties is specified in the following proposal template subsections. It includes: (1) a brief description of your company(s) background; (2) the advanced battery technology being proposed; (3) the development plan for the technology; (4)

the proposed program deliverables, timing, and cost-share; (5) any formal or informal teaming arrangements planned; and (6) acknowledgement of export control compliance.

USABC does not expect to award contracts on the sole basis of responses to this RFPI. All responses will be considered by representatives of the partners and other participants and will be ranked in order of merit. The submitters of the most promising proposals will be contacted by USABC to enter into negotiations which may lead to firm contractual arrangements. If the government and other funding become available, as now expected, USABC intends to award one or more development contracts. However, nothing herein should be interpreted as a commitment to award a contract.

Information requested below should be answered as thoroughly as possible within a maximum of twenty five pages, in total, for the response to the RFPI. Your submission package should be sent via electronic mail and shall contain a cover letter, a complete copy of your proposal and, a signed copy of the RFPI Agreement. All technical and financial material submitted to the USABC must be in the English language. If you have any questions concerning the RFPI, please contact Vijay Saharan @ (586) 907-2901or Maureen LaHote @ (313) 910-3720.

NOTWITHSTANDING PROPOSER'S MARKINGS TO THE CONTRARY, ALL INFORMATION SUBMITTED IN RESPONSE TO THIS USABC RFPI SHALL BE TREATED ON A NON-CONFIDENTIAL BASIS.

ALL PROPOSALS ARE TO BE SUBMITTED TO THE CONSORTIUM IN ACCORDANCE WITH THE ATTACHED RFPI AGREEMENT WHICH MUST BE EXECUTED WITHOUT MODIFICATION AND ACCOMPANY THE PROPOSAL. NO PROPOSAL SHALL BE EVALUATED BY THE CONSORTIUM WITHOUT PRIOR EXECUTION OF SUCH RFPI AGREEMENT.

SEND, VIA ELECTRONIC MAIL, YOUR PROPOSAL (including signed RFPI Agreement) TO:

Maureen LaHote
Business Manager
United States Advanced Battery Consortium
E-mail: mlahote@uscar.org

7.0 Proposal Template

7.1 Brief Company Background / Overview

- Company structure and ownership
- Relevant product lines
- Manufacturing and product locations
- Experience with commercialization of relevant product lines; in particular automotive OEMs
- Financial summary

- Summary of total resources (including breakdown) allocated to relevant product lines over the last three years and forecasted for the project period

7.2 Technology Program Introduction

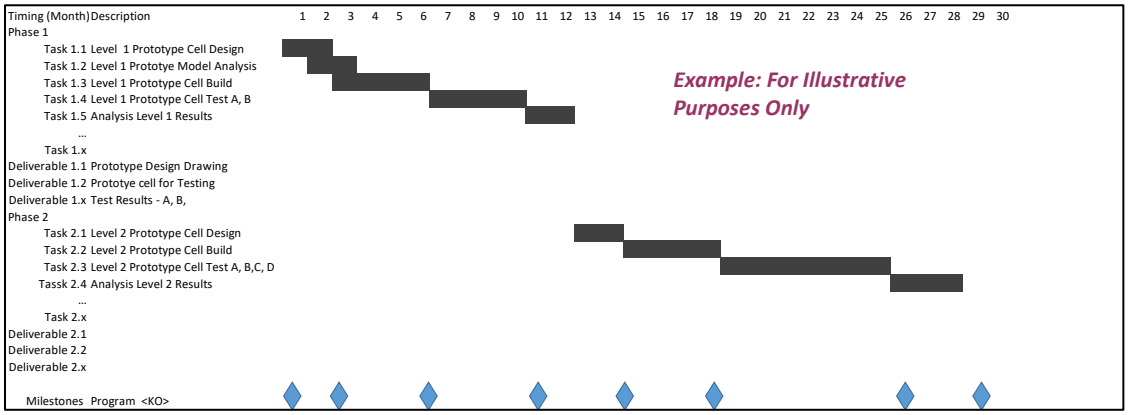
- Technology description and statement of project objective.
- What distinguishes this from other technologies and/or approaches?
- Approximate length of program
- End of Program Objectives in relation to USABC goals
    - Gap Analysis using Appendix A
- Technology Background
    - Current Technology Status including analysis and test results
        - Physical, performance, and life characteristics
    - Constraints or limitations associated with technology
        - Packaging, safety, manufacturing, recycling, quality, etc.
    - Technical challenges
        - Challenges to be addressed during course of project work

7.3 Program Description

- Gap analysis comparing current state of technology with USABC targets (Appendix A and B)
- Identify which areas of the technology need development work
- Clearly state program goals and objectives and compare to USABC goals
- Provide Program Development Timeline
    - Identify main tasks and deliverables included in timeline, describe by key elements
        - Identify any sub-tasks that have been identified
- Provide a cost model for technology and plan to address cost gap, use USABC cost model provided here
    - http://www.uscar.org/guest/article_view.php?articles_id=143

7.4 Development Timing Plan

Example Timing Chart:



- List of Milestones — Timing (Months)
  - Program <KO> — Month 1
  - Design Complete — Month 4
  - …
  - …

7.5 Program Test Plan

Test Plan Pro-Forma/ Example

Tests	In-House Cell		National Lab-Cell		Other Facility	Comments
	10	40	10	40		
Nail Penetration	X	X	X	X		Must not exceed EUCAR4
Cycle Life 30°C	X	X	X	X		Meet goal
Test 3						Meet goal
Test 4						
Test 5						

Test plan Note: If two or more systems are being developed, provide a test plan for each

7.6 Program Cost, Budget and Cost Sharing

- Proposed program budget Including breakdown of labor, materials, indirect costs, etc. using EERE 335 Budget form (link: http://www.uscar.org/guest/article_view.php?articles_id=87, spending rate over project period
- Provide separate budget analysis showing program costs allocated by task
- Describe proposed cost share (a minimum of 50 percent developer cost share is contractually required)
- Provide confirmation that at least 75% of the direct labor billed to USABC for this project will be incurred within the United States

7.7 Program Management

- Provide list of key personnel, in particular program manager, and % time allocated to the project
- Provide a brief resume of key personnel to be assigned to the project

7.8 Export Control Compliance

- The proposer will be required to acknowledge that export control rules limit or prohibit the transfer of covered technology to foreign nationals and agrees to establish and maintain internal controls and procedures adequate to insure accurate determination by the proposer of whether and when its technology falls within the ranges and definitions of the currently effective export control regime

RFPI AGREEMENT

NOTWITHSTANDING PROPOSER'S MARKINGS TO THE CONTRARY, ALL INFORMATION SUBMITTED IN RESPONSE TO A UNITED STATES ADVANCED BATTERY CONSORTIUM (USABC) REQUEST FOR PROPOSAL INFORMATION (RFPI) SHALL BE TREATED ON A NON-CONFIDENTIAL BASIS.

AGREED:

BY _____

TITLE _____

PROPOSER _____

DATE _____

APPENDIX A - USABC Goals for Advanced Batteries

USABC Goals for Low-Cost / Fast-Charge Advanced Batteries for EVs - CY 2023

End of Life Characteristics at 30°C	**Units**	**Cell Level**
Peak Discharge Power Density, 30 s Pulse	W/L	1400
Peak Specific Discharge Power, 30 s Pulse	W/kg	700
Peak Specific Regen Power, 10 s Pulse	W/kg	300
Available Energy Density @ C/3 Discharge Rate	Wh/L	550
Available Specific Energy @ C/3 Discharge Rate	Wh/kg	275
Available Energy @ C/3 Discharge Rate	kWh	50
Calendar Life	Years	10
DST Discharge Throughput, Discharge Energy	MWh	50
Cost (@ 250k annual volue)	$/kWh	75
Operating Environment	°C	-30 to +52
Normal Recharge Time	Hours	< 7 Hours, J1772
Fast High Rate Charge	Minutes	80% ΔSOC in 15 min
Minimum Operating Voltage	V	>0.55 Vmax
Unassisted Operating at Low Temperature	%	> 70% Useable Energy @ C/3 Discharge rate at -20 °C
Survival Temperature Range, 24 Hr	°C	-40 to+ 66
Maximum Self-discharge	%/month	< 1

NOTES

i. Values correspond to End-of-Life (EOL) at 30°C.
ii. Refer to USABC EV testing manual for the definitions and testing procedures

APPENDIX B –Attributes of Cell Technology Proposed for LC/FC EV Cells – CY 2023

Cell Level Attributes (supplied by developer)	Units	Current State (baseline)	End of Program Target
Cell Capacity (1-C discharge)	**Ah**		
Cell Volume (without terminals/tabs)	**Liter**		
Cell Mass	**g**		
$Vmin_{0}$, $Vmax_{100}$ (0 and 100% SOC)	**V**		
$Vmax_{op}$ (top of operating range; fixed at BOL)	**V**		
Vnominal	**V**		
$Vmax_{pulse}$, $Vmin_{pulse}$, $Vmin_{LowT}$	**V**		
Energy Density (volumetric)	**Wh/l**		
Specific Energy	**Wh/g**		
Power Density (10 sec. HPPC power)	**W/l**		
Specific Power (10 sec. HPPC power)	**W/g**		
Target Cost / unit (1 million cells/annum rate)	**$**		
Cost:Energy (basis: usable energy)	**$/Wh**		
Cell Chemistry (cathode/anode)			
Electrolyte ($LiPF_6$/other/etc.)			
Separator (polyolefin/polyolefin with ceramic content/etc.)			
Cell format (can/pouch)			
Electrode format (stacked/wound)			
Cell dimensions: (height x width x thickness)	**mmxmmxmm**		
Proposed Architecture to Achieve System Targets			
Battery Size Factor (BSF)	**#**		
Parallel-Series Configuration	**__p__s**		

NOTE

i Values correspond to Beginning-of-Life (BOL)