



COORDINATING RESEARCH COUNCIL, INC.

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WWW.CRCAO.ORG

October 12, 2022

In reply, refer to:

CRC Project No. AVFL-45

Dear Prospective Bidder:

The Coordinating Research Council (CRC) invites you to submit a written proposal to provide services for “Impacts of Thermal Conditioning on Battery Packs Efficiency, Range, and GHG Reduction – Literature Review” (CRC Project No. AVFL-45). A description of the project is presented in Exhibit A, “Statement of Work.”

Please indicate your intention to bid at [this link](#) on or before **October 27, 2022** if you or your organization intends to submit a written proposal for this research program. CRC will answer technical questions regarding the Request for Proposal if they are submitted in writing at least one week before the proposal submission deadline here: [Q & A Link](#). CRC will then return written answers to all of the bidders, along with a copy of the original questions. Questions submitted within a week of the deadline may not be answered before the proposal submission deadline.

A CRC technical group composed of industry representatives will evaluate your proposal. CRC reserves the right to accept or reject any or all proposals.

The reporting requirements will be monthly progress reports and a summary technical report at the end of the contractual period. The reporting requirements are described in more detail in the attachment entitled “Reports” (Exhibit B).

The proposal must be submitted as two separate documents. The technical approach to the problem will be described in part one, and a cost breakdown that is priced by task will be described in part two. The cost proposal document should include all costs associated with conducting the proposed program. The technical proposal shall not be longer than 10 pages in length.

CRC expects to negotiate a cost-plus fixed fee or cost reimbursement contract for the research program.

Contract language for intellectual property and liability clauses is presented in Exhibit C and in Exhibit D, respectively.

Important selection factors to be taken into account are listed in Exhibit E. CRC evaluation procedures require the technical group to complete a thorough technical evaluation before considering costs. After developing a recommendation based on technical considerations, the costs are revealed and the recommendation is modified as needed.

Electronic copies of the technical and cost proposals should be submitted to:

Amber Leland
Coordinating Research Council
5755 North Point Parkway, Suite 265
Alpharetta, GA 30022

Phone: 678-795-0506
Fax: 678-795-0509
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The deadline for receipt of your proposal is **November 13, 2022.**

Yours truly,

Amber B. Leland
Deputy Director

EXHIBIT A: Statement of Work

“Impacts of Thermal Conditioning on Battery Packs Efficiency, Range, and GHG Reduction - Literature Review”

CRC Project Number: AVFL-45

Background

As the light-duty automotive segment shifts towards electrification, challenges regarding EV use under different ambient temperature conditions throughout the year remain. Charging and operating EVs at extreme temperatures is known to have temporary as well as potentially permanent effects on battery function. Cold temperatures slow down the electrochemical processes taking place in the cells, which results in slower charging and reduced range. On the other hand, hot temperatures make it more difficult to dissipate the heat generated in the battery pack as needed in order to avoid thermal runaway. Therefore, thermal management of the EV battery is critical; effective thermal management could result in an enhanced user experience while still maintaining the state of health of the battery, which could have an indirect impact on the overall GHG emissions. While several solutions exist today to address these issues [1], it remains unclear what their effects are on user experience, battery health and resulting GHG emissions. An assessment of the different thermal management techniques that seek to optimize the trade-offs amongst the factors determining battery healthy operation, overall efficiency and user experience is needed in order to inform further EV technology development.

Objective

Collect information about 1) battery thermal preconditioning methods relevant to automotive applications being used and developed in different settings, 2) the impacts of each of these methods on overall energy efficiency, charging time, vehicle range, battery life, and GHG Scopes 1, 2, and 3, as defined by the Greenhouse Gas Protocol [2], and 3) an analysis on the viability of the different methods and the gaps in research areas where future focus will be needed for EV development and GHG emissions reduction.

Scope of Work

Perform a literature review of publicly-available information including articles, research reports/publications and patents in industry, academia, or government settings*. Topics for review include:

- Description of battery thermal conditioning methods relevant to automotive applications currently being used and explored
 - Internal and external (to the battery) methods [1]
 - Methods that use only in-vehicle systems and methods that require interaction with a charger
 - Methods used and explored in any market in the world
- Impacts of each method described and dependence on different factors
 - Impacts on user experience include
 - Charging time
 - Battery performance
 - Vehicle range
 - Battery life
 - Environmental impacts include
 - Well-to-wheel energy efficiency
 - GHG Scopes 1, 2, and 3
 - The dependence of the impacts above on different factors including

*Only English language literature is expected to be reviewed

- Ambient temperature dependence
 - Method's operating parameters dependence (if applicable)
- An analysis of the technical challenges of the different methods and the gaps in research and areas where future focus will be needed for EV development on GHG emissions.
 - Evaluate strengths and weaknesses of the various methods
 - Assess the level of development of the different methods

Schedule

Expected to require no more than 6 months.

Deliverables

Deliverables include:

- A kickoff call with the CRC project panel and contractor to discuss project scope and align expectations.
- A mid-project call with the CRC project panel and contractor to discuss preliminary results and identify any information gaps before finalizing findings and starting the final report.
- The CRC project panel may schedule additional calls with the contractor as needed during the project duration to discuss issues that arise.
- Brief written monthly progress reports to inform the CRC project panel. These reports describe at a high level what was done in the previous month, what is planned for the next month, and problems encountered, if any.
- A final report, the draft of which will be reviewed by the CRC project panel and AVFL committee before final release.

References

1. Qin, Y., Du, J., Lu, L., Gao, M., Haase, F., Li, J., & Ouyang, M. (2020). A rapid lithium-ion battery heating method based on bidirectional pulsed current: Heating effect and impact on battery life. *Applied Energy*, 280, 115957.
2. The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, 2015

Cost Estimate

Rough estimate \$30k based on similar previous projects.

EXHIBIT B

REPORTS

MONTHLY TECHNICAL PROGRESS REPORTS

The contractor shall submit a monthly technical progress report covering work accomplished during each calendar month of the contract performance. An electronic Microsoft® Word compatible file (<1 MB) of the monthly technical progress report shall be distributed by the contractor within ten (10) calendar days after the end of each reporting period. The report shall contain a description of overall progress, plus a separate description for each task or other logical segment of work on which effort was expended during the reporting period.

FINAL REPORT

The contractor shall submit to or distribute for CRC an electronic (Microsoft Word) copy transmittable via email) of a rough draft of a final report within thirty (30) days after completion of the technical effort specified in the contract. The report shall document, in detail, the test program and all of the work performed under the contract. The report shall include tables, graphs, diagrams, curves, sketches, photographs and drawings in sufficient detail to comprehensively explain the test program and results achieved under the contract. The report shall be complete in itself and contain no reference, directly or indirectly, to the monthly report(s).

The draft report must have appropriate editorial review corrections made by the contractor prior to submission to CRC to avoid obvious formatting, grammar, and spelling errors. The report should be written in a formal technical style employing a format that best communicates the work conducted, results observed, and conclusions derived. Standard practice typically calls for a CRC Title Page, Disclaimer Statement, Foreword/Preface, Table of Contents, List of Figures, List of Tables, List of Acronyms and Abbreviations, Executive Summary, Background, Approach (including a full description of all experimental materials and methods), Results, Conclusions, List of References, and Appendices as appropriate for the scope of the study. Reports submitted to CRC shall be written with a degree of skill and care customarily required by professionals engaged in the same trade and /or profession.

Within thirty (30) days after receipt of the approved draft copy of the final report, the contractor shall make the requested changes and deliver to CRC ten (10) hardcopies including a reproducible master copy of the final report. The final report shall also be submitted as electronic copies in a pdf and Microsoft Word file format. The final report may be prepared using the contractor's standard format, acknowledging author and sponsors. An outside CRC cover page will be provided by CRC. The electronic copy will be made available for posting on the CRC website.

EXHIBIT C

INTELLECTUAL PROPERTY RIGHTS

Title to all inventions, improvements, and data, hereinafter, collectively referred to as ("Inventions"), whether or not patentable, resulting from the performance of work under this Agreement shall be assigned to CRC. Contractor X shall promptly disclose to CRC any Invention which is made or conceived by Contractor X, its employees, agents, or representatives, either alone or jointly with others, during the term of this agreement, which result from the performance of work under this agreement, or are a result of confidential information provided to Contractor X by CRC or its Participants. Contractor X agrees to assign to CRC the entire right, title, and interest in and to any and all such Inventions, and to execute and cause its employees or representatives to execute such documents as may be required to file applications and to obtain patents covering such Inventions in CRC's name or in the name of CRC's Participants or nominees. At CRC's expense, Contractor X shall provide reasonable assistance to CRC or its designee in obtaining patents on such Inventions.

To the extent that a CRC member makes available any of its intellectual property (including but not limited to patents, patent applications, copyrighted material, trade secrets, or trademarks) to Contractor X, Contractor X shall have only a limited license to such intellectual property for the sole purpose of performing work pursuant to this Agreement and shall have no other right or license, express or implied, or by estoppel. To the extent a CRC member contributes materials, tangible items, or information for use in the project, Contractor X acknowledges that it obtains only the right to use the materials, items, or information supplied for the purposes of performing the work provided for in this Agreement, and obtains no rights to copy, distribute, disclose, make, use, sell or offer to sell such materials or items outside of the performance of this Agreement.

EXHIBIT D

LIABILITY

It is agreed and understood that _____ is acting as an independent contractor in the performance of any and all work hereunder and, as such, has control over the performance of such work. _____ agrees to indemnify and defend CRC from and against any and all liabilities, claims, and expenses incident thereto (including, for example, reasonable attorneys' fees) which CRC may hereafter incur, become responsible for or pay out as a result of death or bodily injury to any person or destruction or damage to any property, caused, in whole or in part, by _____'s performance of, or failure to perform, the work hereunder or any other act of omission in connection therewith.

EXHIBIT E

PROPOSAL EVALUATION CRITERIA

- 1) Merits of proposed technical approach.
- 2) Previous performance on related research studies.
- 3) Personnel available for proposed study – related experience.
- 4) Timeliness of study completion.
- 5) Cost.