



COORDINATING RESEARCH COUNCIL, INC.

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February 3, 2015

In reply, refer to:

CRC Project No. CM-138-15-1

Dear Prospective Bidder:

The Coordinating Research Council (CRC) invites you to submit a written proposal to provide services for "Development of a Thermodynamics-Based Fundamental Model for Prediction of Gasoline-Ethanol Blend Properties and Vehicle Driveability" (CRC Project No. CM-138-15-1). A description of the project is presented in Exhibit A, "Statement of Work."

Please indicate by letter, fax, or email by **February 17, 2015**, 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. CRC will then return written answers to all of the bidders, along with a copy of the original questions.

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 ten 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:

Dr. Chris Tennant
Coordinating Research Council
5755 North Point Parkway, Suite 265
Alpharetta, GA 30022

Phone: 678-795-0506
Fax: 678-795-0509
E-mail: ctennant@crcao.org

The deadline for receipt of your proposal is **March 3, 2015**.

Yours truly,

Christopher J. Tennant
Deputy Director

EXHIBIT A
Statement of Work - Request for Proposal
Project CM-138-15-1

Development of a Thermodynamics-Based Fundamental Model for Prediction of Gasoline-Ethanol Blend Properties and Vehicle Driveability

Background

The Problem - Gasoline vapor pressure is adjusted for ambient temperature and altitude for good engine cold start. This required adjustment mostly affects the front end volatility (T10 and below) of the fuel. However, once the engine starts, the gasoline must continue to vaporize to ensure that the mixture is rich enough to burn properly and deliver good warm-up driveability, until the fuel-facing surfaces of the engine have warmed sufficiently to vaporize most if not all of the fuel. Over the years it was determined that the mid-range boiling point (T50) was the most important of three distillation points (T10, T50 and T90) and an equation that predicted Driveability Index (DI) was developed and successfully implemented.

$$\text{DI (hydrocarbon only)} = 1.5 \cdot T10 + 3.0 \cdot T50 + T90 \quad \text{EQ 1.}$$

Blending ethanol into gasoline has two effects on the gasoline. One is to increase the heat of vaporization, which potentially retards evaporation and could affect driveability. The other is to lower the distillation temperatures, particularly the T50 temperature, that is critical in the DI calculation. The degree to which the T50 is depressed depends on the base gasoline properties and the amount of ethanol added.

Test programs have been developed and executed to define the effects of ethanol on the DI equation and vehicle performance. While the T50 depression effects of ethanol are well known, the effort and expense of vehicle test programs have limited the number of fuels investigated in these programs. The resulting ethanol corrections to the DI equation may not be representative for fuels significantly different from those from which the corrections were derived. The current DI equations based on regressions of vehicle performance test data are¹:

$$\text{DI (for 0 -10v\% EtOH blends)} = 1.5 \cdot T10 + 3.0 \cdot T50 + T90 + 2.4 \cdot \text{Vol.\% EtOH} \quad \text{EQ. 2}$$

$$\text{DI (for 15-20v\% EtOH blends)} = 1.5 \cdot T10 + 3.0 \cdot T50 + T90 + 9.6 \cdot \text{Vol.\% EtOH} \quad \text{EQ. 3}$$

As ethanol levels in gasoline rise there are concerns that potential errors in the ethanol correction to the DI equation are increasing. Perhaps a more fundamental evaluation of the ethanol effect would yield better results.

¹ CRC Report 666 - 2013 CRC Intermediate-Temperature E15 Cold-Start and Warm-Up Vehicle Driveability Program

Objective

It is well known that ethanol when blended into gasoline affects the blend volatility properties in a non-linear manner. From the discussion above, it is also well known that the performance of modern light duty vehicles are affected by the Driveability Index of the fuel.

CRC is proposing a project to qualified contractors to take a more fundamental approach toward describing the effects of blending ethanol into gasoline on the blend distillation properties and the driveability of vehicles using gasoline-ethanol blends. Such an approach perhaps could be based more on the non-linear thermodynamic relationships between gasoline hydrocarbon components and ethanol, rather than the brute-force regression approach used today in the ASTM gasoline standard D4814.

Specifically the objectives for the project are:

1. Develop a thermodynamics-based approach to predicting the distillation properties of blends of hydrocarbon gasoline and fuel-grade ethanol based on commonly measured properties of gasoline and ethanol.
2. Review past CRC and any other studies on the driveability performance of vehicles with gasoline and gasoline-ethanol blends and develop a better model for predicting driveability index of gasoline ethanol blended fuels.

This new approach should use readily and commonly measured properties for gasoline, fuel blending ethanol, and gasoline-ethanol blends to be useful. For example, a correlation based on detailed hydrocarbon analysis (DHA) and ethanol component analysis may be the most fundamental approach but practically not useful, since such information is hardly ever available on a regular inspection test of gasoline.

Scope

The project will not involve the creation of new test data for gasoline or vehicles. Rather, existing CRC and any other publically-available driveability data and fuels' inspections will be used to develop this new model. It is envisioned that this project can be completed within six months or less time.

Resources

Significant historic and recent CRC data are available on driveability and fuels inspections for the contractor. Significant blend studies of gasoline with ethanol are available from API. Digital versions of these data tables will be provided as available as well as the public CRC report documents. CRC members are experts in the fuels and automotive industries and will be available to consult with the contractor on regular project reviews and other, mutually convenient meetings as needed .

Reporting

After CRC reviews proposals, and awards the project, the successful bidder will participate in a kick-off meeting with the CRC project team and CRC management. Monthly teleconferences with the CRC project team with brief status reports will be planned and scheduled at mutually convenient dates and times. A final report will be prepared by the contractor and reviewed for comment by the project team. The contractor will make reasonable changes to the document per the comments of the project team.

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 (pdf or Microsoft® Word compatible) file (<3 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 compatible file 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).

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) printed and bound copies of the final report. The final report shall also be submitted as an electronic copy in both a pdf and a Microsoft® Word compatible 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.