



COORDINATING RESEARCH COUNCIL, INC.

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ALPHARETTA, GA 30022

TEL: 678/795-0506 FAX: 678/795-0509

WWW.CRCAO.ORG

June 13, 2016

In reply, refer to:

CRC Project No. AVFL-29

Dear Prospective Bidder:

The Coordinating Research Council (CRC) invites you to submit a written proposal to provide services for "Enhanced Speciation of Gasoline" (CRC Project No. AVFL-29). A description of the project is presented in Exhibit A, "Statement of Work."

Please indicate by letter, fax, or email by **June 24, 2016** 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 and government representatives will evaluate your proposal. CRC reserves the right to accept or reject any or all proposals. Bidders are advised that the U.S. Environmental Protection Agency (EPA) and the California Air Resources Board (CARB) have expressed interest in possible co-funding of this project area and that certain government contractual terms may be included in any agreement that may be negotiated if you are selected by the proposal evaluation team for funding. EPA and/or CARB may also elect to have separate agreements established with a successful bidder.

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 but may also elect to conduct the desired work through a fixed price agreement.

Contract language for intellectual property and liability clauses is presented in Exhibit C and in Exhibit D, respectively. Bidders are also advised that government funds may be used to support

the research, and therefore certain government contract terms and conditions may apply as noted above.

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:

Brent K. Bailey
Coordinating Research Council
5755 North Point Parkway, Suite 265
Alpharetta, GA 30022
E-mail: bkbailey@crcao.org

Phone: 678-795-0506

Fax: 678-795-0509

The deadline for receipt of your proposal is **August 5, 2016**.

Yours truly,

A handwritten signature in blue ink that reads "Brent K. Bailey". The signature is written in a cursive, flowing style.

Brent K. Bailey
Executive Director

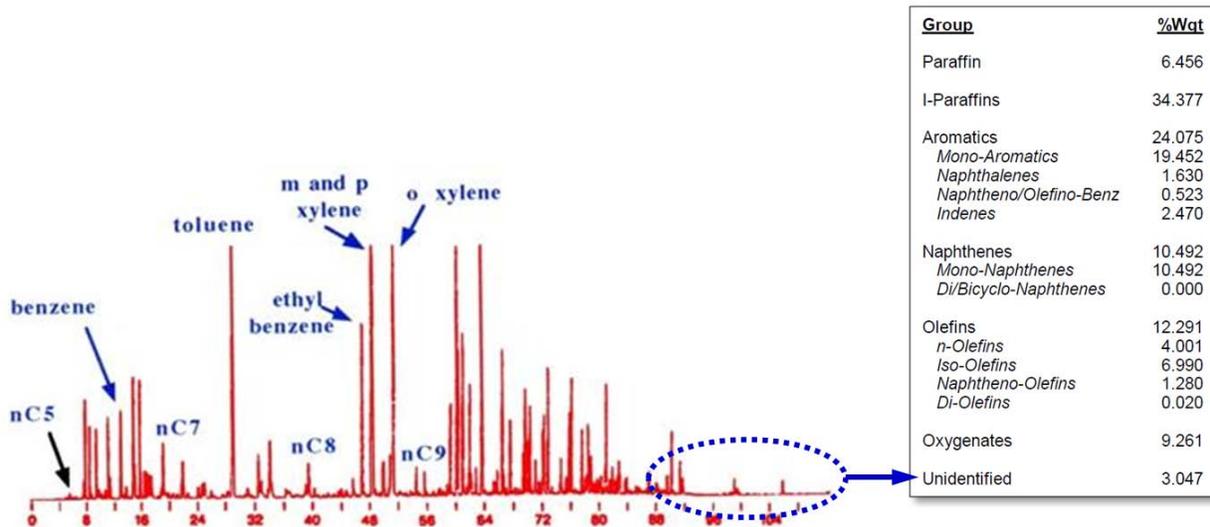
Exhibit A - Statement of Work

Enhanced Speciation of Gasoline

Background

The EPA, Honda, and others have confirmed that the PM Index (PMI) can reasonably predict the relative particulate-forming tendency of a gasoline.^{1,2,3,4,5} The PMI is a function of the vapor pressure and double bond equivalent (DBE) of each component of the fuel. Therefore, the accuracy of the PMI is contingent upon the accuracy of the analytical method used to speciate and quantify the individual components.

A typical method used for this purpose is ASTM D6730, or a variation thereof. This is a gas chromatography method in which many species are left unidentified, typically those eluting late in the chromatogram. Even skilled labs can leave ≥5% of the species unidentified. Given that many species eluting late in the chromatogram can have a substantial contribution to PMI, unidentified or misidentified peaks in this region can result in an inaccurate PMI determination. (See figures below.)



$$PM\ Index = \sum_{i=1}^n \left(\frac{DBE_i + 1}{V.P(443K)_i} \times Wt_i \right)$$

	VP (kPa)	DBE*	PMI Factor
n-tetradecane	10.3	0	0.0971
biphenyl	9.87	8	0.912

- For a constant concentration and vapor pressure, the PM Index factor becomes directly proportional to the DBE term.
- Therefore, if an alkane were to be misidentified as an aromatic, the PM Index factor assigned to that species could be as much as 10x too high.

*DBE = (2C+2-H+N)/2

Objective

The objective of this program is to develop an enhanced method for the speciation of gasoline. The method should be developed to the extent that it can be shared with an appropriate ASTM subcommittee for final development, including the determination of precision and bias. Desired attributes of the method:

- Capable of being used on a routine basis by an average chemical analysis laboratory.
- Easy to perform qualitative and quantitative calibration. A detector with a linear response to pure hydrocarbons is preferred, to minimize the number of species in the calibrant.
- Provides accurate quantification of oxygenated species.
- Resolves, identifies, and quantifies species to the greatest reasonable extent. Identifies specific isomers whenever possible; compound class and carbon number are the minimum identification requirements for species > C9. At a minimum, 99.5 wt% of the sample should be identified. In the case of gas chromatography analyses, this requirement can be defined as 99.5% of the aggregate peak area.
- Provides boiling point estimates for all species.
- Capable of quantifying species with a boiling point up to 280°C.

Scope of Work

Overview

It is recognized that the method attributes listed above may not be achievable in a single-step development process. For example, a research-grade instrument could first be used to achieve optimum component resolution and to establish identifications. The CRC will provide one or more samples of "challenging" gasoline for the purpose of method development. The output from the research instrument using these samples could then be used to establish the requirements for a routine method.

The following is an example of what these steps could look like. The instruments mentioned in these steps are only examples; respondents to this proposal are free to use whatever instruments and methods they deem to be appropriate.

Step 1: Research Phase

One potential technique to determine component resolution requirements and identification is GCxGC-MS (2-dimensional gas chromatography with detection by mass spectrometry). This instrument requires a well-trained operator, is not easy to calibrate (for a multi-component sample), and generates an enormous amount of information. However, analyzing the CRC-provided samples with this instrument could help guide the development of the routine method.

Step 2: Development of Routine Method

The method requirements established in the research phase will help determine the hardware requirements for the routine method. Some examples of instruments that could be used are listed below, in decreasing order of complexity:

- GCxGC-FID; (as above, but with a flame ionization detector).
- Standard GC hardware with FID detection, perhaps with column switching capability. Column length(s) and stationary phase(s) could be optimized to achieve the desired resolution. Peak identifications would need to be re-confirmed with a mass spectrometer during initial method set-up.
- A current DHA method (e.g. ASTM D6730) with an augmented peak table. Multiple detectors (of different technologies) could be used to address co-elutions and uncertainty in component identifications. As above, an MS detector would ideally be used during method set-up.

Schedule

CRC estimates a 6-month to 1-year project completion time including receipt of final approvals on all deliverables by CRC. (Please see attached reporting requirements.) However, bidders are encouraged to submit their best estimate for efficiently completing the work they propose.

References (chronologic)

1. Aikawa, K., Sakurai, T., Jetter, J., "Development of a Predictive Model for Gasoline Vehicle Particulate Matter Emissions," SAE Technical Paper 2010-10-25, 2010.
2. Leach, F., Stone, R., Richardson, D., "The Influence of Fuel Properties on Particulate Number Emissions from a Direct Ignition Spark Ignition Engine," SAE Technical Paper 2013-04-08, 2013.
3. Aikawa, K., Jetter, J., "Impact of Gasoline Composition on Particulate Matter Emissions from a Direct-Injection Gasoline Engine: Applicability of the Particulate Matter Index," *International Journal of Engine Research*, vol. 15, no. 3, pp.298-306, 2014.
4. Sobotowski, R., Butler, A., Guerra, Z., "A Pilot Study of Fuel Impacts on PM Emissions from Light-Duty Gasoline Vehicles," SAE Technical Paper 2015-04-01, 2015.
5. Butler, A., Sobotowski, R., Hoffman, G., Machiele, P., "Influence of Fuel PM Index and Ethanol Content on Particulate Emissions from Light-Duty Gasoline Vehicles," SAE Technical Paper 2015-04-14, 2015.

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 (<2 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 pdf-compatible 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 thirty (30) hardcopies including a reproducible master copy of the final report. The final report shall also be submitted as an electronic copy in a pdf or pdf-convertible 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 of Contractor 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.