



**COORDINATING RESEARCH COUNCIL, INC.**

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**January 17, 2023**

In reply, refer to:  
CRC Project No. E-134

Dear Prospective Bidder:

The Coordinating Research Council (CRC) invites you to submit a written proposal to provide services for “Light Duty PEMS Phase 3: PEMS Performance at Altitude, Grade and Low Temperature Test Program” (CRC Project No. E-134). A description of the project is presented in Exhibit A, “Statement of Work.”

Please indicate if you or your organization intends to submit a written proposal for this research program using [the form submission at this link](#) by **January 30, 2023**. CRC will answer technical questions regarding the Request for Proposal if they are submitted in writing via [this link](#). 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. Key contract language examples are presented in Exhibits B, C, D, and E. CRC must adhere to standard contract language with minor adjustments only in extraordinary circumstances. **Failure to agree to these contract clauses as written may result in the project being awarded to another contractor.**

Important selection factors are listed in Exhibit F. 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.

**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 should not be longer than 10 pages in length (not including resumes). **The schedule / timeline information must be included in the technical proposal; failure to do so may result in your proposal being set aside as non-responsive.**

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

The technical and cost proposals should be submitted to  
**Amber B. Leland** Email: [aleland@crcao.org](mailto:aleland@crcao.org)

The deadline for receipt of your proposal is **FEBRUARY 20, 2023**.

**EXHIBIT A**  
**CRC Project Statement of Work**

**Light Duty PEMS Phase 3: PEMS Performance at Altitude, Grade and  
Low Temperature Test Program**

**Background**

With Europe adopting the use of portable emissions measurement systems (PEMS) to determine light duty real world emissions, there is a greater interest in PEMS functionality and use. The California Air Resources Board (CARB) and the Environmental Protection Agency (EPA) are also conducting PEMS tests with light duty vehicles to evaluate their viability for measuring real world on-road emissions. Potentially, a PEMS test would serve as an addition to the normal Federal Test Procedure (FTP-75), Highway Fuel Economy Test (HWFET), and US06 Supplemental Federal Test Procedures (SFTP) chassis dynamometer testing. Several PEMS manufacturers are producing these units and some studies have been conducted to understand their performance compared to chassis dynamometer-based measurements made using conditions representative of vehicle operation at sea-level, zero grade and under moderate average ambient temperatures. This project seeks to evaluate the performance of PEMS vis-a-vis chassis dynamometer-based tests for measuring emissions from vehicles representative of a range of engine technologies and using a matrix of fuels representative of a range of properties to operate under severe test conditions (including high altitude, steep grades and low temperatures)..

**Objective**

The objective of this program is to: (a) develop an on-road vehicle driving cycle incorporating urban and highway driving at altitude over steep grades and under wintertime ambient temperatures, and (b) compare/evaluate its use in measuring on-road emissions detected by a PEMS mounted on a vehicle and tested on the road versus those collected while operating the same vehicle on a chassis dynamometer in the laboratory over the same driving cycle and test conditions. Emissions measurements, including all gaseous and gravimetric particulate matter (PM) tailpipe emissions, should be collected using a conventional CVS tunnel setup as well as PEMS measurements. Measures should be taken to ensure the vehicle exhaust system is kept at ambient pressure at the tailpipe on the chassis roll during testing. Several engine technologies (up to four vehicles) will be used for testing along with different fuel properties to investigate how well PEMS can detect fuel property impacts on emissions. This test program would use two market Winter fuels, a low- and high-PMI (Particulate Matter Index) fuel, as described by the Honda method. The two fuels will be provided by CRC. There would be two test sets run, with four tests per set for each vehicle-fuel combination. Ideally, sets would be run on consecutive days with a soak in-between, for each test set. One PEMS unit should be sufficient to measure tailpipe emissions during the duration of the program. The same testing will be run on the chassis roll for repeatability, as well as comparison to the PEMS unit.

On-road vehicle PEMS testing could occur in a different location (relative to chassis roll testing) to find proper road gradients. The contractor would be required to determine the on-road location consisting equal portions of city, highway, and rural driving conditions. The total test time would be no more than 45 minutes. The drive route would be duplicated on the chassis roll including grade; specifically:

- Determine the repeatability of the chassis roll testing to compare to the PEMS unit
- Determine repeatability and accuracy of PEMS unit under real on-road driving conditions
- Determine if PEMS unit can measure differences in PMI of fuel for gaseous and PM emissions
- Determine how exhaust flow measurement from the individual PEMS system correlates with the direct vehicle exhaust flow meter from the test cell and with the CVS bags based on CO<sub>2</sub>.

## **Scope of Work**

### Project Management

CRC and its technical project panel will provide management and oversight for this project. These entities are here after referred to collectively as the project sponsor.

### Vehicles

Vehicle selection will be determined by the project sponsor. There will be four light duty gasoline vehicles used for testing. All vehicles will be provided by CRC. Engine parameters from the vehicle including airflow and fuel rates should be measured to calculate exhaust flow for each test. Additionally, a list of engine parameters is to be recorded while testing on either the chassis roll or on-road.

The contractor shares with project sponsor how the PEMS unit will be installed based on PEMS manufactures recommendations for exhaust flow measurements prior to testing.

### Fuels

There will be two Winter market fuels used for testing - one high- and one low-PMI fuel as described by the Honda method. The contractor will be required to store and test the fuels for specific fuel properties listed in Appendix A. The facility should be temperature and humidity controlled. Drum quantities are shown below.

### Real World Drive Cycle

The objective is to develop an on-road cycle, which incorporates city, urban and highway driving. The cycle will be conducted in Winter-like climate conditions using each of the fuels. On-road testing requires high altitude and steep grades as part of the driving route. The total drive time is 45 minutes consisting of 1/3 City, 1/3 highway and 1/3 rural driving.

## Emissions

The chassis dynamometer test cell should be 40 CFR Part 1065/1066 compliant and will measure both bag gaseous emissions (including CO<sub>2</sub>) as well as gravimetric particulate matter (PM) emissions at a frequency of 1 Hz. The PEMS unit will measure TP gaseous and PM emissions. The PEMS unit will be supplied by CRC. Additionally, a direct vehicle exhaust flow meter from the chassis dynamometer will be used for modal measurements and exhaust flow rate comparison to the PEMS.

## Test Procedure

1. Use the fuel change, EVAP canister loading, fuel drain and fill procedures from the CRC E-122 test program for each vehicle and test fuel.
2. Conduct chassis roll emissions testing with measurements from the chassis dynamometer emissions and simultaneous PEMS measurements. Conduct two sets of testing, each set consisting of four repeat runs over consecutive days. The second set is after a fuel change. Each test is a cold start with a soak time of at least 8 hours. All ambient conditions should be measured, air temperature, barometric pressure, humidity, rain, etc.
3. Conduct testing with PEMS unit on real road with same drive cycle as on dynamometer. Each test is a cold start with a soak time of at least 8 hours. All ambient conditions should be measured, air temperature, humidity, rain, etc.
4. Change fuels using fuel change procedure from CRC E-94-2 and CRC E-122.

## Statistics

Contractor will be conducting statistical analysis on all test data. At the halfway point some statistical analysis will be conducted to determine how the program is going. Complete statistical analysis will be conducted on completion of the test program.

## Quote

Please provide a quote on a per-vehicle per-fuel basis, i.e., one vehicle with one fuel. Also, include total cost estimates for all four vehicles and two fuels running each fuel twice. Example: run each vehicle on chassis roll and on road with the high PMI fuel four times in a row. Then change to the low PMI fuel and repeat. Then conduct testing with the high PMI fuel again four times on chassis roll and on road. Change fuel to low PMI and repeat.

## **Deliverables**

A statistician, already contracted, will be participating on all project calls to help make decisions and assist in proper interpretation of all data collected. As outlined in the subsequent "Exhibit" section, the contractor should submit monthly reports in addition to the draft and final reports. Monthly reports should contain all data acquired during the report month using the scan tool, shown in MS Excel chart format when appropriate. Emission test results and drivability notes should also be included. Depending on the final program schedule, the contractor may be requested to

issue an interim report. This interim report would be structured in a format similar to the final report, and would address all vehicles that had completed testing to that point. All data from testing will be provided to the statistician to be used for analysis. The testing contractor will complete a report in the following areas: introduction, experimental setup, graphs, vehicle testing route and emissions plots as needed. Also, pictures will be required of vehicles with the chassis roll emissions lab setup, with PEMS equipment as well. The statistician will add their analysis to the report along with an executive summary and conclusions. The contractor will be required to make all final edits of report as specified by CRC.

## EXHIBIT B

### REPORTS

A. CONTRACTOR shall submit a technical progress report covering work accomplished during each month of the contract performance. 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. Periodic conference calls may also be requested by CRC to update the technical committee overseeing the project.

B. CONTRACTOR shall submit to CRC a draft final report on or before DRAFT FINAL REPORT DUE DATE. The *Draft Final Report* shall be reviewed and returned to CONTRACTOR with comments no later than forty-five (45) days thereafter. The report shall document, in detail, all of the work performed under the contract including data, analyses, and interpretations, as well as recommendations and conclusions based upon results obtained. The report shall include tables, graphs, diagrams, curves, sketches, photographs, and drawings in sufficient detail to comprehensively explain the results achieved under the contract. The report shall be complete in itself and contain no reference, directly or indirectly, to the monthly progress reports and should be suitable for publication in the peer-review literature. Additional rounds of review may be required prior to acceptance of the Final Report. If applicable, data from the research shall be provided in a format suitable for releasing to the public along with the final report.

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 report structure that includes:

- CRC Title Page and Disclaimer Statement (both provided by CRC)
- 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 (may also include Recommendations if CRC requests them)
- List of References
- Appendices as appropriate for the scope of the study.

Incomplete draft reports or reports of poor quality requiring additional outside editorial review may have outside editorial services charged back to the project budget.

## **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 shall promptly disclose to CRC any Invention which is made or conceived by CONTRACTOR, 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 by CRC or its Participants. CONTRACTOR 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 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, CONTRACTOR 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 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**

### **RELATIONSHIP OF PARTIES**

It is agreed and understood that CONTRACTOR is acting as an independent contractor in the performance of any and all work hereunder, and to the extent caused by CONTRACTOR, CONTRACTOR shall be solely liable and responsible for the payment of all legal claims for damages made by its employees or agents, or by another person or persons, on account of any property damage or on account of personal injury sustained or suffered by, or on account of the death, of any person or persons, or on account of any other legal claims arising or growing out of CONTRACTOR's negligence in the performance of the agreement; and CONTRACTOR undertakes to indemnify CRC against any such liability.



## **EXHIBIT E**

### **KEY PERSONNEL REQUIREMENTS**

Certain skilled experienced professional and/or technical personnel are essential for successful performance by CONTRACTOR of its obligations and work under this Agreement. These personnel are persons whose resumes were submitted for evaluation of the Proposal and are identified by CRC as “Key Personnel”. CRC awards contracts based on several requirements and the reputation and experience of Key Personnel are a significant requirement. CONTRACTOR agrees that CONTRACTOR will not remove or replace any Key Personnel from the contract work without compliance with paragraphs (a) and (b) hereof.

(a) If any Key Personnel for whatever reason becomes, or is expected to become, unavailable for work under this Agreement (or any specific Project) for a continuous period exceeding thirty (30) work days, or is not expected to perform the work hours and volume of work indicated in the proposal or initially anticipated, the CONTRACTOR shall immediately notify CRC and shall, subject to the concurrence of CRC, promptly replace such Key Personnel with personnel of at least substantially equal ability and qualifications acceptable to CRC.

(b) All requests for approval of substitutions of Key Personnel hereunder must be in writing to CRC and provide a detailed explanation of the circumstances necessitating the proposed substitutions. Requests for substitution must contain a complete resume for the proposed substitute Key Personnel, and any other information requested by CRC needed to approve or disapprove the proposed substitution. CRC will evaluate such requests and notify CONTRACTOR of approval or disapproval thereof in writing. CRC is not responsible for, and shall not be charged, any fees or other costs related to such replacement Key Personnel’s performance of the services until the replacement Key Consultant has obtained the same proficiency and knowledge regarding the services as the former Key Personnel.

(c) If CRC determines that suitable and timely replacement of Key Personnel who have been reassigned, terminated or have otherwise become unavailable for the contract work is not reasonably forthcoming or that the proposed replacement Key Personnel would impair the successful completion of the contract or the services ordered, at the option of CRC, (i) the Agreement (in whole or in part related to the applicable contract work) may be terminated by CRC or (ii) the contract price or fixed fee may be equitably adjusted downward to compensate CRC for any resultant delay, loss, or damage, in an amount acceptable to CRC

## **EXHIBIT F**

### **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.