



**COORDINATING RESEARCH COUNCIL, INC.**

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**November 5, 2015**

In reply, refer to:

CRC Project No. DP-03-12

Dear Prospective Bidder:

The Coordinating Research Council (CRC) invites you to submit a written proposal to provide services for “Performance Evaluation Protocol for Diesel Vehicles – Effect of Fuel Cetane Number on Vehicle Performance,” (CRC Project No. DP-03-12). A description of the project is presented in Exhibit A, “Statement of Work.”

Please indicate by letter, fax, or email by **November 19, 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 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:

Dr. Christopher J. Tennant  
Coordinating Research Council  
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E-mail: [ctennant@crcao.org](mailto:ctennant@crcao.org)

The deadline for receipt of your proposal is **December 4, 2015**.

Yours truly,

Christopher J. Tennant  
Deputy Director

## **EXHIBIT A**

### **Statement of Work**

#### **Performance Evaluation Protocol for Diesel Vehicles – Effect of Fuel Cetane Number on Vehicle Performance: Scoping Study**

The Cetane Number Panel of the CRC LDD Performance group is interested in developing a procedure that can be used to establish the performance of a diesel vehicle. The purpose of this document is to outline a test protocol to assess the startability and low temperature performance of typical North American Light Duty Diesel vehicles as a function of temperature and fuel cetane number.

The structure of this initial scoping program will be to obtain three representative vehicles and two or three fuels of varying cetane number, and determine the performance of the fuels in the vehicles at conditions of typical ambient (20 +/-1 °C) and low temperature (-25 +/- 1 °C).

Testing will be conducted on a climate controlled chassis dynamometer with cold-soaked vehicles. Each vehicles will be tested at ambient and at -25 °C. At each temperature, each of the three vehicles will be run on all the fuels, and the tests will be completed in duplicate. If two fuel are tested, there would be 24 test runs completed. If three fuels are evaluated, then 36 tests will be conducted. Budgetary considerations will determine if two or three fuels will be tested.

The Cetane Number Panel is soliciting a response to this request for proposal to run the test protocol as outlined in this document. Costing should be provided for a 24 test and a 36 test program. We would also like feedback related to the feasibility of the protocol as proposed, and any thoughts related to the best way to successfully complete the program.

#### **Vehicles**

For this program, three Tier 2 bin 5 US vehicles would be evaluated. These vehicles will be provided by the Panel, and will likely include one pickup, one smaller and one larger passenger car.

If three vehicles cannot be provided, the panel may request the contact lab to purchase one or more vehicles for the test program. These vehicles could be sold at the end of the program, with a credit given for the resale.

#### **Fuels**

Two or three fuels would be procured by the Panel and provided to the successful bidder. We expect that no more than five drums of each of the fuels will be required.

## **Proposed Testing Protocol**

Each vehicle is to be tested on both fuels, and tests will be conducted at both ambient (20 +/- 1 °C) and -25 C (-25 °C +/- 1). Each vehicle/fuel combination will be tested in duplicate, and the testing sequence will be randomized. For ease of testing, all the ambient runs and all the -25 °C runs can be run in groups to minimize the time required for completion. The ambient runs will be conducted first to allow ambient troubleshoot of the vehicles (identifies vehicle issues not temperature related prior to the low temperature test).

We would expect to instrument the vehicles to obtain typical measurements such as oil temperature, exhaust temperature, engine speed, vehicle speed, etc. In addition, we hope to access in car data acquisition info – using the required OBD pid outputs – to acquire a fair amount of performance data.

**Temperatures have been selected to avoid the need for auxiliary or “recommended” starting aids. During the low temperature testing, any of the vehicle’s starting aids that may be required for operation at -25 °C are expected to be active. We are trying to avoid the need for “recommended” auxiliary starting aids to come into play.**

## **Protocol**

**Conduct initial vehicle check to insure it is in proper working order**

**Change oil using recommended oil viscosity grade for each vehicle for operation at -25 °C for all testing.**

**Instrument vehicles for testing**

**Change to test fuel**

- **Drain current fuel**
  - Note: some vehicles may have sample port in bottom of fuel tank to facilitate draining the fuel.
- **Flush**
  - Add approximately five gallons of the next fuel to be tested to the fuel tank.
  - Purge vehicle fuel system. Run vehicle long enough to flush the entire fuel system volume, and record the approximate amount of fuel used for the purge.
  - Drain and discard fuel.

### **Prepare vehicle for testing**

- Fill vehicle fuel tank with the next fuel to be tested. Add approximately ¼ of the normal fill volume of the tank.
- Start vehicle and run for 10 minutes.
- Record in test log any irregularities as well as time, date and fuel number added to vehicle.

**Overnight soak at test temperature (12 hours) – Battery will be left in the vehicle at test temperature, but kept on a trickle charger. Record either the block or oil sump temperature during the cold soak period. An appropriate temperature reading from the ECU may be used if the reading can be made without the engine on or the glow plug (if one is installed), remains off.**

### **Move to test cell for testing**

- Install vehicle in test cell, install on dynamometer rolls
- Complete instrumentation hook up
  - Ensure that data collection of has been started
  - 1 Hz data collection is acceptable for slow-changing parameters, but higher speed acquisition is required for adequate resolution of of other parameters, e.g. crankshaft rotation, engine speed, etc.
    - 100 Hz preferred, 10 Hz minimum

### **Phase 1 - Start vehicle - Startability determinations**

**This phase is meant to start the vehicle, measuring startability performance. Vehicle data should be captured during the start process, including time for engine speed rise and crankshaft acceleration**

1. Start the engine using the starting procedure recommended in the owner’s manual by the OEM. Use no external or auxiliary starting aids. Note those aids **required** by the manufacturer (e.g. block heaters at very low temperatures) when operating at -25 +/- 1 °C.
  - a. If the engine stalls or fails to start during the first ten seconds of idling restart the engine. If the engine again stalls or fails to start, terminate the cold start test. Report the result as “Failed to start”.
  - b. Remove the vehicle from the test cell.
  - c. Move to warm location to recondition the vehicle. Run vehicle up to operating temperature (to typical oil temperature)
2. Repeat overnight soak, then attempt to start the engine again (on day two)
  - a. If the engine stalls or fails to start during the first ten seconds of idling restart the engine. If the engine again stalls or fails to start, terminate the cold start test. Report the result as “Failed to start”.
  - b. Remove vehicle from test cell – no additional testing will be conducted on the vehicle at -25 +/- 1 °C.

## **Driver performance recordings**

Assess the qualitative performance of the diesel vehicle, which could be affected in different ways. Some effects, in order of severity include:

- An observable effect upon performance.
- Slight fluctuation of speed (surge), engine misfire, or the need for significant pedal adjustment to maintain speed.
- Monitor vehicle and engine speed.
- Stalling of engine.

As appropriate during the testing, the driver of the vehicle should keep written record of these performance observations.

## **Data Capture – Measurements**

### **Primary list of desired measurements**

- Engine cranking RPM
- Driveability/startability - Slope of starting crankshaft rotation during start up
- Dynamic crankshaft measurements are to be recorded throughout the test
- Driveability malfunctions
- Misfire detection (OBD parameter associated with misfire or combustion sensitivity)
- Delta pressure across the fuel filter
- White smoke - tailpipe smoke opacity

## **Phase 2 – Initial vehicle idle determinations**

- a. Switch on all electric accessories at their maximum power (head lights and running lights on, heater on full defrost, rear window defroster on), and keep, or leave, the engine at its normal start-up idle for 1 min and 30 seconds after starting.
- b. Gather engine performance data during this idle stage

## **Data Capture – Measurements**

### **Primary list of desired measurements**

- Dynamic crankshaft measurements are to be recorded throughout the test
- Driveability malfunctions
- Misfire detection (OBD parameter associated with misfire or combustion sensitivity)
- Delta pressure across the fuel filter
- White smoke - tailpipe smoke opacity

Again, any driver observations of performance should be recorded, and may include:

- An observable effect upon performance.
- Slight fluctuation of speed (surge), engine misfire, or the need for significant pedal adjustment to maintain speed.
- Monitor vehicle and engine speed.
- Stalling of engine.

### **Phase 3 – Acceleration and cruise determinations**

- a. Accelerate through the gears to reach 60 km/h (37.5 mph) within approximately 30 seconds. For vehicles with automatic transmission, allow the transmission, to dictate the shifts, with gear selector in “D”. For each vehicle equipped with a manual transmission determine a suitable engine speed for gear change. Thereafter always change at this engine speed in order to ensure consistency from test to test. If a stall occurs, restart the engine immediately and perform the acceleration again. Note the occurrence of the stall and record the length of time when engine was not operating.
- b. Drive at 60 km/h in the appropriate gear. Gather data for 60 seconds.
- c. At 2 min 35 sec, accelerate at full load up to 110 km/h (68.75 mph) within approximately 25 sec.
- d. Drive at 110 km/h in the highest gear. Gather data for 60 seconds.

### **Data Capture – Measurements**

#### **Primary list of desired measurements**

- Dynamic crankshaft measurements are to be recorded throughout the test
- Driveability malfunctions
- Misfire detection (OBD parameter associated with misfire or combustion sensitivity)
- Delta pressure across the fuel filter
- White smoke - tailpipe smoke opacity

#### **Other items of interest**

Please comment on your capability to run these additional determinations. How could these measurements be made? What additional cost and complexity would be introduced by trying to make these measurements?

- Noise – high frequency color spectral plot of noise
- Fuel consumption during steady state cruise modes
- HC and CO emissions as an indicator of misfire

### **Data reporting**

Data is to be provided in an appropriate format. We will also need to have follow-up discussions regarding the best approach to analyze the various data generated.

There may be a desire to re-run testing if the repeats fall outside of some range of repeatability. This will be determined at a later date. Can you provide a statement regarding the cost and timing implications of such re-runs?

### **Project timing**

Please comment on estimated timing for completion of the work.

## **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).

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 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.