COORDINATING RESEARCH COUNCIL, INC.
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ALPHARETTA, GA 30022
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February 5, 2013
In reply, refer to:
CRC Project No. DP-05-12

Dear Prospective Bidder:

The Coordinating Research Council (CRC) invites you to submit a written proposal to provide services for "Effect of Wax Settling and Biodiesel Impurities on Light-Duty Diesel Performance" (CRC Project No. DP-05-12). A description of the project is presented in Exhibit A, "Statement of Work."

Please indicate by letter, fax, or email by **February 19, 2013** 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. Chris Tennant
Coordinating Research Council
3650 Mansell Road, Suite 140
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 5, 2013.**

Yours truly,

Chris Tennant
Deputy Director

EXHIBIT A

Statement of Work

CRC Diesel Performance Group, Joint Biodiesel – Low Temperature Operability Panel (CRC Project DP-05-12)

The Effect of Wax Settling and Biodiesel Impurities on Light-Duty Diesel Performance

Objectives

The objective of this study is to test vehicle operability for a range of biodiesel containing fuels over a "weekend" diurnal cooling cycle. This may reveal wax, saturated FAME, or saturated monoglyceride (SMG) settling. It may also reveal insolubility of SMG that may not be observable on shorter timescales. The study will evaluate the predictive ability of bench test results for low-temperature performance (CP, CFPP, etc.) of B5 blends by comparing with actual light-duty diesel (LDD) vehicle performance on an all-weather chassis dynamometer. The study will follow protocols similar to those used in the CRC Diesel Performance Group low-temperature performance study conducted previously,[1] and also similar to those described by Chandler.[2]

Context

After running a series of laboratory tests simulating weekend temperature conditions on stored fuel, visual and analytical evidence of wax settling in ULSD/Biodiesel/Jet No. 1 Fuel blend combinations was found (Phase 1). The degree of wax settling changes depending on length of stagnant storage. Cloud, CFPP and Pour Point measurements top and bottom levels of fuels stored under simulated weekend conditions confirm a layering effect and the potential for field issues. In some biodiesel blend samples the bottom was enriched in glycerides. LTFT testing after temperature cycling does not indicate wax settling is an issue, but this may be due to the stirring step in that standard test method. Significant CFPP test differences for top and bottom samples of fuel stored under simulated low temperature weekend storage conditions indicate potential light duty vehicle operability issues.

Scope of Work

Testing will be conducted on an all-weather chassis dynamometer using vehicles with fuel systems covering the range found in the vehicle fleet today.

[1] Coordinating Research Council, "Evaluation of Low Temperature Operability Performance of Light-Duty Diesel Vehicles for North America" CRC Report No. 649, November 2007.
[2] Chandler, J.E. "Comparison of All Weather Chassis Dynamometer Low Temperature Operability Limits for Heavy and Light Duty Trucks with Standard Laboratory Methods" SAE Tech. Pap. No. 962197 (1996).

Fuels and Fuel Characterization: Hydrocarbon base fuels will include a No. 2 diesel with CP below -14°C (7°F) and a No. 1 diesel with CP of approximately -40°C (-40°F). Four B100 blendstocks will be obtained:

1. Low CP (0°C, 32°F) with monoglyceride in the 0.5 to 0.6 wt% range
2. Low CP (0°C) with monoglyceride in the 0.3 wt% range
3. High CP (10°C, 50°F) with monoglyceride in the 0.5 to 0.6 wt% range
4. High CP (10°C) with monoglyceride in the 0.3 wt% range

The hydrocarbon materials will be tested to ensure compliance with the D975 standard and the B100 materials will be tested to ensure compliance with the D6751 standard. Additionally, the hydrocarbon materials will be evaluated for CP, CFPP, and LTFT; as well as wax distribution. The B100 will be tested for SMG content in addition to total monoglycerides.

The study focuses on low level Bxx blends that are the most common in the market today. B10 blends could be tested if additional funding became available. Priority is given to 0°C CP B100 because this makes up 50% of the market today and because blending of high CP B100 is less prevalent in the winter. The fuel test matrix is show in Table 1. Blend cloud points are not specified exactly, but all are targeted at below -20°C (-4°F). Especially for the animal fat blends we may need to use more No. 1 diesel, or alternatively at the discretion of the work group we can go with CP above -20°C if it is close. A control without biodiesel or additive is included, with the goal of testing the vehicles at the lowest planned test temperature to determine if they will operate. Public data suggested issues for using 100% kerosene as the blendstock. A test with a B5/Kero blend is included. The study investigates B100 total MG level, with a target high level of 0.5 to 0.6 wt% and a target low level of 0.3 wt%. The high MG level B100 may be difficult to find in the November to February time frame. It is anticipated that approximately 200 gal of each blended fuel will be required.

Additives that are thought to prevent wax settling and also provide improved operability below cloud point will be tested. Additive selection will be made by FATG from the ACC if more than one additive supplier offers to provide the additive performance required.

Table 1. Matrix of test fuel blends.

Test	Vol% No. 2	Vol % No. 1	Vol% Bio	Bio CP, °C	Blend CP, °C	Additive	Operability Target, °C	Purpose
1	30	70	0	--	-28 (-18°F)	no	CP	Control
2	35	60	5*	0	<-20 (<-4°F)	no	CP	Low CP B100/ high MG
3	35	60	5*	0	<-20 (<-4°F)	yes	10C below CP	Low CP B100/ high MG+additive
4	35	60	5‡	0	<-20 (<-4°F)	no	CP	Low CP B100/ low MG
5	35	60	5‡	0	<-20 (<-4°F)	yes	10C below CP	Low CP B100/ low MG+additive
6	30	65	5*	>10	<-20 (<-4°F)	no	CP	High CP B100 with high MG
7	30	65	5‡	>10	<-20 (<-4°F)	no	CP	High CP B100/ low MG
8	0	95	5#	#	TBD	no	CP	Investigate field issues observed for No. 1 blends

*B100 total monoglyceride level >0.4 wt% (target 0.5 to 0.6 wt%)
‡B100 total monoglyceride level<0.4 wt% (target 0.3 wt%)
#B100 to be determined

Vehicles: Three light duty vehicles will be acquired for the term of the study. The contractor will ensure that each vehicle's fuel system conforms to the engine manufacturer's recommendations (i.e. with respect to fuel filter location), and if not will modify the vehicle to bring the fuel system configuration in line with manufacturer recommendations. The vehicles will be fitted with pressure transducers before and after the fuel filter to measure any increase in pressure drop caused by filter plugging. Thermocouples will be placed in the fuel tank, in the return line, and both before and after the fuel filter. Vehicles will be fueled such that at no time during the test of a given fuel does the tank level get below 50%. The contractor is encouraged to review test vehicle preparations as described in CRC Report No. 649.[1]

Vehicle Testing: Testing will be conducted using an All Weather Chassis Dynamometer or a similar facility. The eight test fuels listed in Table 1 will be tested in each vehicle. Vehicles are flushed with fresh fuel and then filled before each test. Vehicles are cooled using a weekend simulation cooling cycle that drops temperature to below CP overnight, and warms to slightly above CP during the day. Testing would commence on the final day either at CP for non-additized fuels or 10°C below CP for additized fuels. The test temperature should be within 1°C of the specified temperature. Tests fuels 2-7 should have similar CP which may facilitate an efficient approach to testing the 3 vehicles on multiple fuels and the contractor should consider proposing the lowest cost approach. An example cooling cycle for a fuel with CP of -10C and CFPP of -22C is shown in Figure 1.

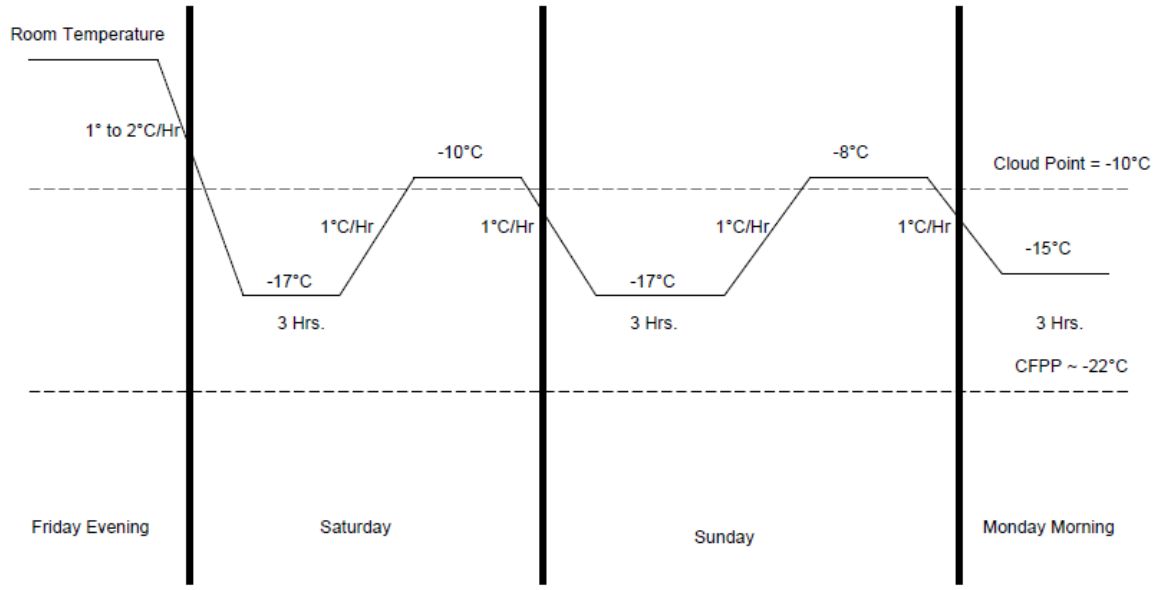

Figure 1. Example weekend simulation cooling cycle.

Tests will employ the following sequence (see CRC Report 649 for additional details):

1. After the diurnal cooling, the vehicle is started using fully charged, warm batteries. A dedicated battery for each vehicle will be fully charged at room temperature, then moved into the test cell and connected to the vehicle just prior to starting of the vehicle.
2. If the vehicle starts, idle for 2 minutes and 30 seconds.
3. Switch on all electric accessories at their maximum power (head lights, lights, de-icing, vent, …), and keep, or leave, the engine at fast idling for 30 seconds after cranking.
4. Start the timer for the beginning of the operability test, and accelerate through the gears so as to reach 60 km/h in the appropriate gear within approximately 35 seconds. For each vehicle determine a suitable engine speed for gear change. Thereafter always change at this engine speed in order to ensure consistency from test to test. For vehicles with automatic transmission, allow the transmission, to dictate the shifts, with gear selector in "D". 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.
5. Drive at 60 km/h in the appropriate gear.
6. At 3 min 35 s, accelerate at full load up to 110 km/h. within approximately 25 sec.
7. Drive at 110 km/h in the highest gear and maintain, if possible, for 30 min.
8. The total test time is 34 min. including the acceleration phase. Failing tests could include: failure to start, failure to idle, and failure to reach required speed. A borderline result is one in which required speed was attained but could not be maintained.
9. The contractor will monitor vehicle speed, engine speed, fuel system pressures and fuel system temperatures throughout the test with continuous data logging.

For test fuels without additive a passing or failing test at CP will be considered the definitive result of the study. For fuels containing additive a passing or failing test at 10°C below CP will be considered the definitive result of the study.

Fuel Sampling: One gallon samples of all fuel blends will be acquired at the time the fuel is put into the vehicle fuel tanks. These samples will be taken in one gallon epoxy-lined metal cans, sealed, and stored indoors. Additionally, at the completion of the weekend cooling simulation cycle, but before the vehicle is started, samples will be taken from the vehicle fuel tank through the fill neck. These samples will include 500 ml from the bottom of the tank and a second 500 ml from near the top. Epoxy-lined metal containers are preferred but the contractor may propose a different container with equivalent properties. These samples will be clearly labeled as to fuel being tested, vehicle, test temperature, and date. Visual observations of these samples (for example: cloudy, precipitate, cloudy with precipitate, etc.) will be reported. All fuel samples will be shipped to a location to be determined by CRC for further evaluation.

Deliverable

A detailed final report of all vehicle testing results will be provided. The fuel characterization and blending test labs will provide a detailed letter report to include tables of all data acquired. Upon approval of these reports, CRC will provide the reports to the vehicle test lab so that they are aware of bench low-temperature operability test results and so that the letter reports can be included as an appendix to the detailed final report that the vehicle test lab will provide.

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 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).

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 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.