



COORDINATING RESEARCH COUNCIL, INC.

5755 NORTH POINT PARKWAY, SUITE 265
ALPHARETTA, GA 30022
TEL: 678/795-0506 FAX: 678/795-0509
WWW.CRCAO.ORG

May 21, 2014

In reply, refer to:

CRC Project No. E-94-2

Dear Prospective Bidder:

The Coordinating Research Council (CRC) invites you to submit a written proposal to provide services for “Fuel Effects on Gaseous and Particulate Emissions On SIDI In-Use Vehicles,” (CRC Project No. E-94-2). A description of the project is presented in Exhibit A, “Statement of Work.”

Please indicate by letter, fax, or email by **June 4, 2014** 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
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 **June 18, 2014**.

Yours truly,

Christopher J. Tennant
Deputy Director

EXHIBIT A

Statement of Work Fuel Effects on Gaseous and Particulate Emissions On SIDI In-Use Vehicles

Background

The recently adopted CAFE and GHG emissions standards for model year 2017-2025 light-duty vehicles are significantly more stringent than those applicable to current production. . This has influenced manufacturers to develop new engine technologies, such as spark ignited direct injection (SIDI) gasoline engines, to improve fuel economy. Currently many manufacturers are producing both naturally aspirated (NA) and turbo-charged SIDI engines in light-duty vehicles and are meeting both gaseous and PM emissions standards with E0 certification fuel. Europe is implementing, for the first time, a particulate number (PN) standard starting with the impending EURO VI emissions regulations. In the United States, the state of California also is considering a PN standard. There is an interest to investigate the fuels impacts on in-use vehicles with SIDI engine in terms of gaseous (regulated and unregulated), PM and PN emissions influenced by varying fuel parameters.

Objectives

Three vehicles from the CRC E-94-1 program will be used for testing and additional vehicles will be purchased for this program. This work is to better understand how a range of SIDI engine technologies are impacted by various fuel parameters. Both Turbo-charged and naturally aspirated engines will be used for testing to better understand the emissions from each technology. This program will start with 10 vehicles for testing with the potential for additional vehicles, budget permitting.

- Determine gaseous and PM/PN emissions with E0 and E10 fuels.
- Determine fuels impacts on gaseous and PM/PN emissions and particulate morphology with turbocharged and naturally aspirated engine technologies
- Determine differences between turbocharged and naturally aspirated engine technologies

Scope of Work

Project Management

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

Fuels

There will be eight fuels used for testing. The fuels will be purchased by CRC directly and should not be budgeted for in the quote. Several fuel properties are varied in this program such as RON, ethanol and PMI. The fuels matrix is shown below in Table 1. There will be 500 gallons of each of the eight fuels purchased for the 12 vehicles used for testing.

CRC E94-2 Fuels Matrix										
Fuel		Tolerance	A	B	C	D	E	F	G	H
RON		0.5	91	91	91	91	98	98	98	98
MON			83	83	83	83	88	88	88	88
AKI			87	87	87	87	93	93	93	93
Sensitivity		-	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Aromatics	vol. %	2	25	25	25	25	25	25	25	25
PMI	Honda Eq	0.2	1.4 Max	2.4 Min	1.4 Max	2.4 Min	1.4 Max	2.4 Min	1.4 Max	2.4 Min
RVP	psi		6.5-7.5	6.5-7.5	6.5-7.5	6.5-7.5	6.5-7.5	6.5-7.5	6.5-7.5	6.5-7.5
Ethanol	vol. %	0.5	10	10	0	0	10	10	0	0
Sulfur	ppmw	2	10	10	10	10	10	10	10	10
Benzene	vol. %	0.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Olefins	vol. %	2	4.0-6.0	4.0-6.0	4.0-6.0	4.0-6.0	4.0-6.0	4.0-6.0	4.0-6.0	4.0-6.0
T50	deg F	10	170-210	170-210	170-210	170-210	170-210	170-210	170-210	170-210
T90	deg F	10	300-350	300-350	300-350	300-350	300-350	300-350	300-350	300-350
C9 Aromatics	Vol %	1	<4	>8	<4	>8	<4	>8	<4	>8

Table 1: Fuels Matrix Properties

Notes on the fuel matrix:

- The blender must use the same set of blending components for all fuels, and each component must be used at a level of at least 2 v%.
- Each component must have a boiling range of at least 50 degrees F, determined as the difference between its T₉₀ and T₁₀.
- The blending components may be modified by distillation with the approval of CRC.
- Exceptions may be granted with the expressed permission of CRC. Such exceptions may include the substitution of one or more blending components with similar material.
- The test matrix will explicitly control PMI as defined by Honda. While variation of the PMI will result in the variation of other parameters such as C₉₊ aromatics content and FBP, those other parameters if possible will not be explicitly controlled.
- PMI, T50 and T90 must all be within the range specified, and the minimum and maximum values for the individual fuels cannot differ by more than the tolerance.

The fuel will be kept in drums for testing on the suppliers grounds.

Vehicles

- The project sponsor will provide guidance in the selection of appropriate test vehicles to be purchased for this program. All vehicles will meet Tier 2 Bin 5 emission standards or lower. A list of vehicles to be used in this program is shown below in Table 2.

Year	Manufacturer	Model	Configuration	Displacement	Turbo	E94-1	E94-2
2011	GM	Equinox	L4	2.4L	no	X	X
2013	Ford	F150	V6	3.5L	yes	X	X
2012	VW	GTI	L4	2.0L	yes	X	X
2013	Ford	Focus ST/ 6 speed man trans	L4	2.0L	yes		X
2013	Ford	Focus/ 5 speed man trans	L4	2.0L	no		X
2010	Nisan	Juke	L4	1.6L	yes		X
2007-2012	Toyota/Lexus	GS-350	V6	3.5L D4S	no		X
2013	GM	Mailbu	L4	2.0L	yes		X
2013	GM	Malibu	L4	2.5L	no		X
2014	Mazda	Mazda6	L4	2.5L	no		X
2013	Hyundai	Azera	V6	3.3L	no		X
2013	Honda	Accord	L4	2.4L	no		X

Table 2. Vehicle List

- Potential test vehicles shall be screened to exclude those with engine modifications/tampering, damaged or missing aftertreatment systems, OBD codes, etc. Candidate vehicles will also be screened to confirm that they meet other appropriate criteria specified by the project sponsor. Note that the screening described in this section will primarily be the responsibility of the project sponsor. The vehicles could be from the same city to reduce screening and logistics time.
- If all selection criteria have been met, the project sponsor will make the final decision regarding the purchase of the vehicle. The contractor will be responsible for the purchase of the vehicle and transportation to the test location.
- For the purpose of submitting a quotation, test vehicles will be acquired as part of the quote for this program. All quotes submitted to the project sponsor should list the cost required to purchase each test vehicle separately. A total cost to purchase all the vehicles should also be listed on the quote
- The project sponsor could request that additional vehicles be added to the program. To address this possibility, please provide a supplemental quote on a per-vehicle basis. This quote would cover all related program costs, but would exclude the vehicle purchase cost.
- The quote should have a separate line item cost to obtain vehicle information, (spark advance/retard, fuel trim...) on a per test fuel per test vehicle basis
- The quote should have a separate line item cost to obtain particulate morphology on a per test fuel per test vehicle basis
- The quote should include the cost to acquire 4,000 miles break-in on any brand new vehicle that needs to be purchased for this study. CRC will specify what fuel and drive cycle to use.

- Baseline emission testing over a standard Unified test cycle (LA92) using E0 shall be performed to confirm that the vehicle emissions system is performing properly. If the vehicle fails to perform properly, the project sponsor shall be contacted for guidance.
- Fuel economy, regulated and unregulated emissions and PM/PN data for all emissions tests completed as a part of this test program shall be provided to the project sponsor.

Test Procedure (see Appendix 1)

1. Drain existing fuel from the vehicle. Flush with the test fuel using appropriate fuel change procedures, provided in Appendix 2. Fill tank with nominally 40% of fuel tank volume of test fuel. It may be challenging to completely drain the existing fuel in some vehicles, due to the tank design. Therefore, the ethanol and octane number of the test fuel in the vehicle shall be confirmed before proceeding with the next steps. This can be accomplished by analyzing the fuel after it has circulated through the fuel system. For example, the fuel can be analyzed in a laboratory, or through other means suggested by the contractor.
2. Equip the vehicle with a “scan tool,” and configure the device to continuously record the following parameters in real time:

Absolute Throttle Position (%)
Relative Throttle Position (%)
Absolute Throttle Position B (%)
Commanded Throttle Actuator Control (%)
Intake Manifold Absolute Pressure (kPaA)
MAF (g/s)
Ignition Timing Advance Cyl. #1 (Deg)
Bank 1 - Sensor 1 lambda (Wide Range O2S)
Absolute Load Value (%)
Short Term Fuel Trim - Bank 1 (%)
Short Term Fuel Trim - Bank 2 (%)
Long-term Fuel trim Bank 1 (%)
Long-term Fuel trim Bank 2 (%)
Engine RPM (RPM)
Vehicle Speed (km/hr)
Calculated LOAD Value (%)
Engine Coolant Temperature (C)
Commanded Evaporative Purge (%)
Bank 1 - Sensor 1 O2 Voltage (v)
Intake Air Temp (Deg C)
Commanded Equivalence Ratio ()

Note: Any MIL lights and codes should be noted

3. One LA92 test cycle shall be run as a prep cycle followed by a soak time of at least eight hours, but no more than 24 hours before running the LA92 emissions test cycle.

4. While on the LA92 test cycle all tailpipe gaseous emissions will be collected along with 1065 PM filter sample and instantaneous particulate number emissions. Fuel economy and GHG emissions (CO₂, N₂O and methane) are also to be collected.
 - a. -- For PM number (i.e. PN): Solid particles >23 in size.
 - b. -- For PM mass: Standard filter method using the EPA 1065 protocol.
 - c. -- Real-time Black Carbon or soot (mass-based): AVL Micro-Soot Sensor or equivalent
 - d. -- PM size distribution: EEPS or similar
 - e. Determine soot morphology using OC/EC also amount of sulfur contained in particulate.
5. Other unregulated emissions such as acetaldehyde, formaldehyde, ammonia, etc... will be quoted as a separate item
6. Note any drivability issues. Drivability is not a focus of this program, but obvious issues should be noted. Examples include long crank times, rough idle, hesitation/stumble, etc. Note any instances of MIL illumination. In some cases, the MIL may go out after an engine stop/start event; such “temporary” MILs should also be recorded.
7. Run a second test on the same fuel before moving to the next test fuel.
8. Check to see if the two test results are within the test protocol before moving to the next fuel. A potential to have 25% of the testing run a third test should be included in the budget.
9. Test repeat protocol:

Emissions Criteria	% Between Tests
Total Hydrocarbons (g/mi)	30%
Carbon Monoxide (g/mi)	50%
NOx (g/mi)	50%

Test Repeat Protocol

10. Repeat steps 1 through 6 with each test fuel. If the vehicle experiences no apparent problems (driveability, DTC, MIL, etc.) with a particular ethanol blend or octane number, contact the project sponsor to inform them the fuel has been completed and proceed to the next test fuel.
11. The project sponsor may request that a vehicle repeat steps 1 through 6 after undergoing a minor parts exchange. For example, injectors with calibrated flow characteristics could be installed. Such a request would be considered an “additional vehicle,” as outlined in the “Fuels” section.

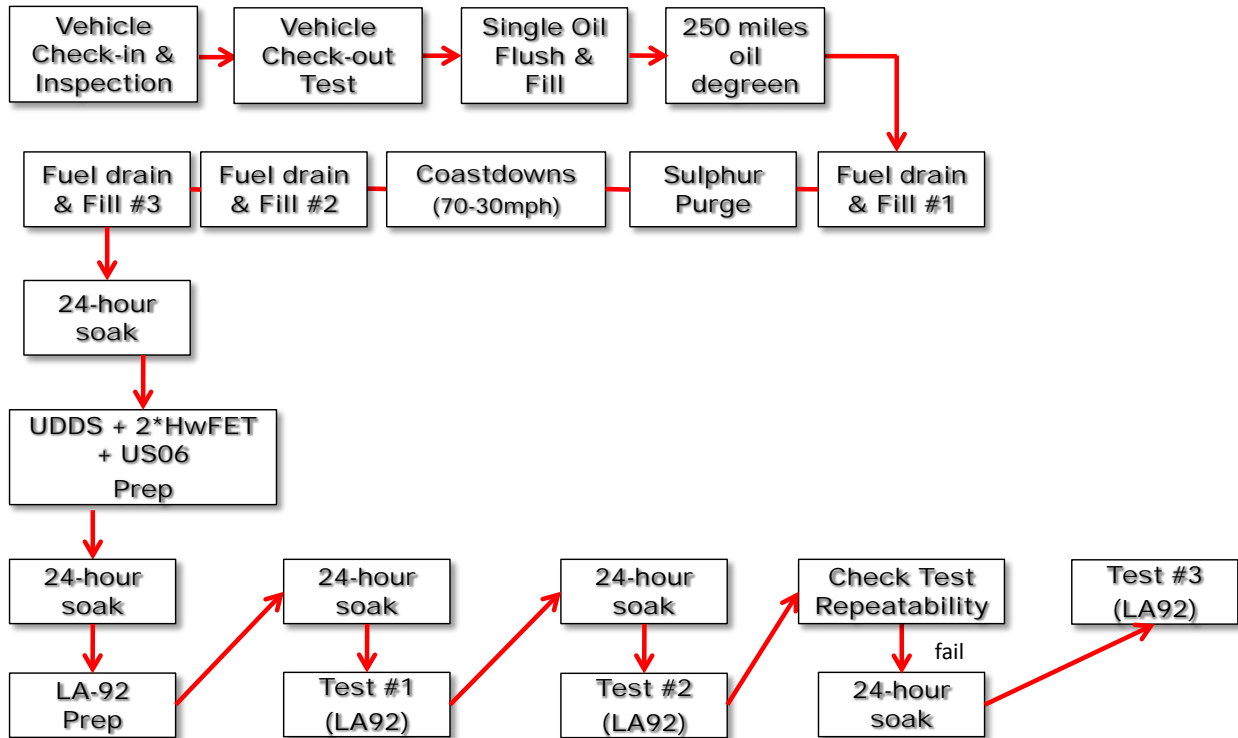
Project Schedule

The contractor is expected to complete testing at an approximate rate of one vehicle per week.

Deliverables

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 driveability 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 format of a final report, and would address all vehicles that had completed testing to that point.

Appendix 1 – Prep and Test Procedure



Appendix 2

Fuel Change, Conditioning, and Test Procedure

1. Drain vehicle fuel completely via fuel rail whenever possible.
2. Turn vehicle ignition to RUN position for 30 seconds to allow controls to allow fuel level reading to stabilize. Confirm the return of fuel gauge reading to zero.
3. Turn ignition off. Fill fuel tank to 40% with next test fuel in sequence. Fill-up fuel temperature must be less than 50°F.
4. Start vehicle and execute catalyst sulfur removal procedure described in Attachment B. Apply side fan cooling to the fuel tank to alleviate the heating effect of the exhaust system. Engine oil temperature in the sump will be measured and recorded during the sulfur removal cycle.
5. Perform four vehicle coast downs from 70 to 30 mph, with the last two measured. The vehicle will be checked for any obvious and gross source of change in the vehicle's mechanical friction if the individual run fails to meet the following repeatability criteria: 1) maximum difference of 0.5 seconds between back-to-back coast down runs from 70 to 30 mph; and 2) maximum ± 7 percent difference in average 70 to 30 mph coast down time from the running average for a given vehicle.
6. Drain fuel and refill to 40% with test fuel. Fill-up fuel must be less than 50°F.
7. Drain fuel again and refill to 40% with test fuel. Fill-up fuel must be less than 50°F.
8. Soak vehicle for at least 12 hours to allow fuel temperature to stabilize to the test temperature.
9. Move vehicle to test area without starting engine. Start vehicle and perform UDDS followed by two HWYFET followed by a US06 test.. During these prep cycles, apply side fan cooling to the fuel tank to alleviate the heating effect of the exhaust system. Following the first two prep cycles, allow vehicle to idle in park for two minutes, then shut-down the engine for 2-5 minutes. Following the last prep cycle, allow the vehicle to idle for two minutes, then shut down the engine in preparation for the soak.
10. Move vehicle to soak area without starting the engine.
11. Park vehicle in soak area at proper temperature (75 °F) for 12-36 hours. During the soak period, maintain the nominal charge of the vehicle's battery using an appropriate charging device.
12. Move vehicle to test area without starting engine.
13. Conduct LA-92 prep cycle. And then soak vehicle for 12-36 hours.
14. Move vehicle to test area without starting engine.
15. Perform LA92 cycle emissions test.
16. Move vehicle to soak area without starting the engine.
17. Park vehicle in soak area of proper temperature for 12-36 hours. During the soak period, maintain the nominal charge of the vehicle's battery using an appropriate charging device.
18. Move vehicle to test area without starting the engine.
19. Perform LA92 emissions test.
20. Determine whether third replicate is necessary, based on data variability criteria (CRC will provide).
21. If a third replicate is required, repeat steps 16, 17, 18 and 19.
22. If third replicate is not required, return to step 1 and proceed with next vehicle in test sequence.

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.

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.