CONTROLLED HYDROGEN FLEET AND INFRASTRUCTURE DEMONSTRATION AND VALIDATION PROJECT

1.0 Project Description

1.1 Project Overview

Transportation accounts for 2/3 of the 20 million barrels of oil consumed each day. The United States currently imports 55% of the petroleum we use. In response to the energy security concerns posed by reliance on foreign sources of energy, as well as concerns about regional air pollution and greenhouse gas emissions, the U.S. Department of Energy (DOE) has initiated a number of programs to develop technologies that offer improved energy efficiency and that produce and utilize energy from diverse domestic and renewable sources.

In the January 2003 State of the Union Address, President Bush reaffirmed the government's commitment to energy independence and an improved environment by proposing $1.2 billion in research funding for hydrogen and fuel cell technologies over the next five years. Subsequently the President proposed a Hydrogen Fuel Initiative that complements FreedomCAR to develop both a low-cost hydrogen infrastructure and advanced hydrogen fuel cell vehicles.

As a result of the President's Initiative, Energy Secretary Spencer Abraham recently detailed a strategy to develop a hydrogen economy that emphasizes co-developing hydrogen infrastructure in parallel with hydrogen fuel cell-powered vehicles to allow a commercialization decision by 2015. In the past, efforts to introduce new energy technologies in the transportation sector have been thwarted by the classic "chicken and egg" dilemma of which comes first; in this case, hydrogen infrastructure or hydrogen vehicles. The Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation project will be an important first step towards achieving the above strategy because the selected consortia will develop complete system solution(s) that will address all elements of infrastructure and vehicle development.

1.2 Scope of Work

The Validation project is designed to support industry efforts and the President's Hydrogen Fuel Initiative in developing a path to a hydrogen economy. The Validation project will seek optimal system solutions to address hydrogen infrastructure and vehicle development, and possible synergies between hydrogen fuel cell electricity generation and transportation applications.

This is a solicitation for a cost shared partnership between government and private sector consortia with the expertise to accomplish the goals of the Validation project. Although other projects may emphasize areas of science and research, the thrust of the Validation project is the testing, demonstration, and validation of hydrogen fuel cell vehicles and infrastructure, and the required vehicle and infrastructure interfaces for optimum system solutions. This Validation project solicitation seeks applications that will accomplish the following goals:

- Test, demonstrate, and validate hydrogen fuel cell vehicle technologies;
- Provide information to the ongoing research and development program;
- Advance the economical and efficient use of hydrogen production and infrastructure components and systems;
- Ensure systems development for vehicle and infrastructure that are national solutions (i.e., for cold and hot climates, and dry and humid conditions);
- Expand the involvement of regional, state and local governments, and the general public with hydrogen vehicle and infrastructure projects;
- Create and implement a comprehensive safety plan and a program that enhances the development of codes and standards;
- Conduct a comprehensive, integrated education and training campaign; and
- Provide a path forward to the commercialization of hydrogen-powered vehicles.

These goals will be accomplished by developing a hydrogen infrastructure and operating hydrogen-powered vehicles at selected U.S. locations. The Validation project provides selected consortia an opportunity to participate in a cost-share demonstration of hydrogen infrastructure and vehicle technologies.

The 5-year Validation project will monitor the operation and performance of hydrogen-powered vehicles spanning two technology development generations. Each applicant will be limited to no more than 50 hydrogen fuel cell vehicles over the two generations and can provide systems in up to three separate regions[1] of the country, with each region providing the required supporting infrastructure for fleet operation. Hydrogen ICE vehicles in generation 1 can be considered where it can contribute to advanced storage system development, advanced hydrogen vehicle development (i.e., low-weight, low drag, hybrid platforms) and/or advanced fueling interface and safety devices for generation 2 fuel cell vehicles. By the second generation vehicle technology, at least one of the geographic regions must be a cold climate region. This infrastructure will include facilities for hydrogen production (reforming, and/or electrolysis), transportation (liquid or gaseous), storage, and refueling.

Prospective applicants shall include at least one hydrogen production system that uses renewable feedstocks for at least part of the hydrogen production at a refueling station. On-site or off-site production will be allowed for renewable resources. Off-site hydrogen production with renewable resources may include using electricity from the grid as long as it is validated as green-power. Off-site production using renewable resources can include, but is not limited to wind, solar, hydro, biomass, and geothermal. On-site hydrogen production is required when using fossil resources such as natural gas reforming.

Stationary facilities that co-produce electricity and hydrogen, and fuel cell vehicles that can be used as potential back-up power systems are viable candidates.

[1] A geographical region is defined as an area with different climatic conditions. The purpose of using different geographical regions is to prove that hydrogen-powered vehicles can operate throughout the U.S. and can, thereby, offer a national solution for energy independence. The applicant will provide data and information to show how these vehicles will eventually be sold in all 50 states.

1.3 Teaming
We expect that the team will include:

1. An automobile manufacturer and an energy company;
2. A hydrogen supplier;
3. A fuel cell supplier;
4. Utility and/or gas company
5. A fleet operator of vehicles (private, local, state, or federal fleets);
6. System and Component suppliers;
7. Small Businesses;
8. Universities, educational, and outreach organizations;
9. State, local, and federal governments.

It is required that either the auto manufacturer or the energy company will be the recipient of the award.

Applications including participation from state/local/federal government agencies are strongly encouraged. Several military bases have been suggested by the Department of Defense as potential participants. They include: hot climate sites (Ft. Irwin, CA; Marine Corps Air Station, Yuma, AZ; Lackland AFB, TX); mild climate sites (Navy Yard, Washington, DC; Marine Corps Recruit Depot, San Diego, CA; Naval Station, Pearl Harbor, HI); cold climate sites (Minot AFB, ND; TACOM/NAC, Warren, MI; Elmendorf AFB, AK). In addition, NASA Kennedy Space Center can also be considered as a site. Existing refueling stations, such as Las Vegas, Nevada, Palm Desert, California, and Sacramento, California, may also be considered.

Neither of the lists referenced above is meant to be prescriptive, and prospective applicants may add or subtract from the lists as appropriate for their project structure.

Deliverables for these federal cost-share projects are listed in Section 1.5 and in Appendix A.

1.4 Cost Share
Federal cost share will be as follows:

- Federal cost share of up to 50% for hydrogen fuel cell vehicles from USCAR auto manufacturers;
- Federal cost share of up to 50% for automobile fuel cells for U.S. fuel cell companies;
- Federal cost share of up to $10,000 per month per application for the purchase of data from non-USCAR auto manufacturers;
- Federal cost share of up to 50% for hydrogen infrastructure;
- Federal cost share of up to 50% for stationary hydrogen fuel cells or up to a maximum of $1,250/kW, for co-production units for integrated networks up to 7.5 MW.

- Federal cost share of up to 25% for generation 1 hydrogen ICE vehicles from USCAR auto manufacturers.

We anticipate that vehicle improvements and parallel R&D during the 5-year schedule will result in lower costs to produce hydrogen-powered vehicles, increased fuel cell durability, and improved vehicle performance and efficiency. At least two generations of vehicles are encouraged, so there may be an opportunity for a short-term lease of first generation vehicles to be followed by leasing one or two more advanced generations of vehicles.

1.5 Reporting Requirements/Deliverables
Deliverables should be defined by the applicants according to DOE requirements and shall include major items as scheduled milestones. The reports below shall be included as deliverables. Additional information on project deliverables can be found in Appendix A.

Table 1

Deliverable	**Frequency**
Project Management Plan	90 days after award with annual updates
Startup Lessons Learned	Annual
Annual Test and Data Collection Plan	90 days after award with annual updates
Vehicle and Facility Training Plan	90 days after award with annual updates
Technical Progress Report, to include reporting and analysis of raw data	Quarterly (One progress report is satisfied by a presentation at the DOE Annual Review Meeting)
Topical Reports Must include: 1. Economic and commercial viability of vehicles at 500K units/year 2. Economic and commercial viability of refueling stations at 1000 refueling stations/year.	As scheduled in work plan Every two years Every two years
Safety Plan	90 days after award with annual updates
Failure Modes and Effects Analysis	Initial with the application and update annually with new data
Risk Mitigation Plan	90 days after award with annual updates
Communication Plan	90 days after award with annual updates
Cost Reports	Monthly

Plans and schedules for vehicle delivery and/or facility installations	As needed
Design packages for maintaining garage and other hydrogen facilities	As needed
Final Technical Report	Once, at project conclusion

To meet the goals of the project, the following measures are presented as 2008 targets:

- 2,000 hours fuel cell stack durability per vehicle;
- Vehicles with a 300+ mile range; and,
- Hydrogen cost of $3/kg, untaxed, when produced in quantity.

2.0 Proposed Award and Period of Performance

It is anticipated that three to five cooperative agreements will be awarded in response to applications to this solicitation. Total government funding is expected to be between $150 million and $240 million. Availability of funding is subject to the annual appropriations process. Periods of performance for the project are expected to be five years (2004 through 2008).

3.0 Eligibility Requirements

The application must meet the following requirements:

- The proposed project must be conducted at a facility located in the United States.
- The applicant must agree to provide the required cost share.
- The applicant shall identify the proposed site and any alternate sites in the application.
- The proposed project team must be clearly identified and firmly committed to fulfilling its proposed role in the project.
- The application must be signed by a responsible official of the proposing organization.
- The application must be consistent with the objectives of this solicitation.
- The application must contain sufficient technical, management, educational, financial, cost, and commercialization information to enable its comprehensive evaluation as described below.
- The applicant must show an awareness and understanding of safety and health issues. This will be evaluated by reviewing the applicant's Failure Modes and Effects Analysis and risk mitigation plan submitted with the application.

4.0 Objective Merit Review Criteria

Applicants are required to prepare technical applications containing detailed work statements based on the requirements listed in this section and the tasks listed in Appendix A. The material referenced in Appendix A identifies the work effort, establishes the required tasks, indicates responsibilities of all parties, and identifies the deliverables and reporting requirements.

The objective merit review criteria establish what DOE considers to be the determining factors for award. Cost will not be point scored, but it will be used in the evaluation process. The objective merit review criteria listed in Table 2 below will be used by evaluators to determine the value of the application in meeting the objectives of the solicitation. The evaluation weights for the objective merit review criteria are shown as percents for each criterion. Sub-criteria within each of these major categories are listed in Sections 4.1-4.6.

Table 2 Objective Merit Review Criteria

4.1	Team organization and project management plan	10%
4.2	Site management plan	10%
4.3	Technical approach	25%
4.4	Performance Data Plan	25%
4.5	Project safety and health	20%
4.6	Education and Training	10%
		100%

4.1 Team Organization and Project Management Plan (10%):
The application shall address the following management structure areas:

a) Identify the team members by organization name, address, phone and fax number, email address, and primary contact name.
b) Provide an organizational chart showing the relationship between each team member and a description of the specific responsibility and authority of each partner.
c) Provide any teaming contract or describe the type of contractual relationship/structure between the various participants in the proposed project team. (e.g. cooperative agreement, joint venture, contractor/subcontractor).
d) Identify the project manager/coordinator and primary contact by organization name, address, phone and fax number, email address, and primary contact name.
e) Describe the team's approach concerning the management of liability issues where tasks are to be jointly executed by different team members.
f) Document any prior relevant and/or current corporate experience for: (1) hydrogen vehicles and infrastructure technologies, and (2) demonstration of new technologies including data collection, assessment, and result formulation to statistically validate project criteria and project objectives. Incorporate the above related project experience in no more than five (5) pages per corporate team entity and include the information in an appendix to the application.
g) Show how knowledge gained through other domestic and/or international hydrogen vehicle and infrastructure projects will be leveraged in this project. Describe any potential/confirmed international coordination relevant to this project.
h) Describe how cross cutting tasks such as training, codes and standards development and education will be coordinated with all team members.
i) Identify key individual(s) for each technology and provide a resume of no more than two-pages per person. Incorporate as an appendix to the application.
j) Capability to provide optimum system solutions

k) Show how small businesses are being incorporated as part of the team

The sub-criteria that will be used to evaluate this plan are as follows:

1. Completeness of the project team, their experience and the ability of the team to obtain all the resources necessary to successfully complete the proposed project.
2. The clarity and logic of the project organization with respect to responsibilities and authorities among project team members.
3. The experience-based capability of the proposed individuals who will represent their company in this demonstration and validation.
4. The soundness and completeness of team relationships as evidenced by the teaming structure.
5. Relevancy to and incorporation of ongoing international hydrogen infrastructure/vehicle activities and/or results.
6. Team approach to training and education, codes and standards, and safety
7. Inclusion of small businesses and universities on the team.

4.2 Site Management (10%):

The application shall address the following areas in its management plan:

a) Provide the business name, address, phone, and fax numbers, email address, and primary contact name of the site owner.
b) Provide a description and blueprint or sketch (may be hand drawn) of the proposed site (including dimensions, topography, and surrounding buildings), available utilities, and design/construction plans for the facility. Include capacities/design basis for the various process and storage units.
c) Provide the city/state permitting requirements at this site and, if applicable, the status of the current permit request. In addition, the applicant will be required to complete a National Environmental Policy Act checklist provided by DOE to determine compliance with the Act. NOTE: the description should outline a carefully considered permitting approach based on schedule optimization for the necessary infrastructure deployment (See Appendix A).
d) Provide a checklist of activities required to prepare the site for operations and a schedule including planning, permitting design, construction, testing, and facility operations. (See Appendix A)
e) Describe the infrastructure startup sequence to bring the proposed facility(ies) to full operation.
f) Briefly describe how the site manager will interface with the various site subcontractors (vehicle suppliers and operators/maintenance staff, hydrogen suppliers, producers, storage and refueling teams as well as the program manager during the operating period).
g) State willingness to participate in quarterly program progress meetings that will be held on a rotating basis at the various project sites.

The sub-criteria that will be used to evaluate this plan are as follow:

1. The extent to which the application will provide information and data relative to the site management process.
2. Adequacy of proposed site and likelihood of timely permit approvals.

3. Soundness of site planning and development approach including the sizing of facilities.
4. Time required to commence site operations.
5. Thoroughness of site management approach to assure achievement of the proposed work objectives.
6. Management approach concerning the development and implementation of necessary codes and standards and ultimately the integration of the hydrogen infrastructure with vehicle operation.

4.3 Technical Approach (25%):
The technical approach shall provide a clear description as to how the applicant will meet the technical requirements under each task in Appendix A. The following areas shall be addressed:

a) Provide the operator name and contact information, describe the type of fleet operation, how the vehicles will be used, and the expected miles per day, week, month, or year.
b) Provide a delivery schedule for the hydrogen vehicles during the five-year project to justify the infrastructure proposed (See Appendix A). If generation 1 vehicles are to be upgraded/ improved/ replaced during the project, the applicant shall list and estimate those changes in the schedule.
c) Explain how the number of vehicles relates to your test plan and the validation of test data to achieve the DOE decision criteria.
    - Provide the type(s) and number of vehicles to be delivered per year, or on a more detailed schedule. List generation 1, generation 2, or generation 3 vehicles, as applicable.
    - Show the relationships between vehicle deliveries and your test plan. For example, if the test plan requires a certain amount of miles to validate durability data, show how the delivery schedule supports this.
d) Describe fully, the proposed vehicle/site facility operation and maintenance (O&M) plan. For example, will staff be independently hired and trained or will they be from the proposer's staff?
e) Provide a monitoring plan listing the type of data collected and the proposed time schedule for sharing and reporting.
f) Applicant should describe which Model Building Code will be used to build and permit the systems proposed for this regional site and provide a chart listing which deviations or alternative equipment standards are referenced to meet the results of the Failure Modes and Effects Analysis to be submitted with the application.
g) If renewable feedstocks are proposed, describe which renewable feedstocks will be used or provide a detailed description of the potential to use renewable resources in subsequent years.
h) Provide a chart listing how cost reductions, reliability improvements and all other pertinent objectives will be realized by 2008. A list of any additional data that will be made available should be added to strengthen the rating of the application.
i) Provide an outline of maintenance and operations programs.
j) Provide an outline of education and training programs.

The sub-criteria that will be used to evaluate this plan are as follow:

1. The extent to which the application will provide data collection and evaluation that will aide DOE in refocusing its R&D activities.
2. The planned level of vehicle use.
3. The potential benefits and lessons learned from the number of vehicles operating under variable climactic conditions, terrain, and other operating variables.
4. The thoroughness of the operation and maintenance plans for the vehicles and infrastructure.
5. The completeness and logic for data collection and evaluation that will lead to advancement to the next phase of commercialization.
6. The degree of updated or state-of-the-art vehicles/production technologies proposed throughout the life of the program.
7. The approach to using renewable resources.

4.4 Performance Data Plan (25%)

The Plan shall provide a clear description defining how the applicant will meet DOE's requirements to supply performance data designed to allow the government and industry to make informed decisions about continued research and development and commercialization. The following areas shall be addressed:

a) Describe the onboard vehicle and other data collection systems that will be used in the project.
b) Provide an outline and description of your data collection plan for vehicles and infrastructure.
c) If vehicle or infrastructure component tests are required "off-site" at manufacturing facilities, or other certified test sites, outline how will this be conducted and how will data be collected and reported.
d) DOE's required data elements are discussed in Section 2 of the SOO. Provide a list and brief discussion of additional data that you will provide and why they are important to the project objectives.
e) Provide your plan for reporting data to DOE with an emphasis on your present plans for evaluating and interpreting crucial data.
f) In coordination with item d) above, describe how you plan to evaluate the accomplishment of project objectives such as stack durability, hydrogen cost and other vehicle performance issues.
g) Describe the types of data that will be needed for industry to evaluate commercialization steps, and how you plan to collect and report such data.
h) Discuss the issue of confidential and proprietary data and describe how you plan to deal with the issue in a way that allows DOE to fairly evaluate project progress.

The sub-criteria that will be used to evaluate this plan are as follows:

1. The extent to which the application will show how the completeness and logic of the plan for data collection and evaluation will lead to advancement to the next phase of commercialization and to help refocus the DOE R&D activities.
2. The willingness and timeliness to provide DOE with data.
3. The willingness to work with DOE and provide supporting data in areas such as simulation models, life cycle assessments, and economic analyses.

4. The completeness and logic for your plan to evaluate data, to assess project accomplishments, and to report important results to the DOE.

4.5 Project Safety(20%):
The application shall address the following areas:

a) Provide the safety record of all the respective applicants and how it was determined. Provide a written example of a safety assessment used by the applicants to install a new system or test a new piece of equipment, include any calculations. Include a table showing the last three years experience of any recordable incident. Present the project or site manager's safety philosophy in related types of project management applications.
b) Complete a comprehensive Failure Modes and Effects Analysis (FMEA) on the project. Use published data when available or use engineering practice if data is not available. Explain the approach if it differs from industry practice.
c) Clearly identify the risk mitigation plan and accident prevention practices that will apply to the project based on the FMEA.
d) Describe how safety performance will be measured and monitored on the project and ensure that the FMEA is updated regularly as data becomes available.
e) Provide a detailed outline for the Communication Plan that the PM will develop and implement during the project. Include a description of reportable accidents, management response, and independent reviews during the design/development and the operations phases of the project in the outline.

The sub-criteria that will be used to evaluate this section are as follow:
1. The extent to which the application will provide information and data to help DOE focus its activities regarding safety.
2. Safety record of the applicants when introduced with new equipment or systems as evidenced by the three most recent years of requested data.
3. Comprehensive Failure Modes and Effects Analysis
4. Risk Mitigation Plan draft
5. Communication Plan draft
6. Site manager's performance monitoring, and approach to accident prevention.
7. Adequacy of reporting, adoption of independent recommendations and DOE oversight plan.

4.6 Education and Training (10%):
The application shall address the following four areas:

a) Provide an outline discussing an education plan to increase public familiarity with hydrogen technology, both within the awarded region and nationally.
b) List the planned products the team will provide for use in education and training efforts.
c) Outline the number, anticipated schedule, and types of events related to education in which each participant anticipates involvement. The education program should be designed to promote the Validation project concept and purpose to regional residents.

d) Provide an outline discussing your team's personnel training plan in regards to facility maintenance and operations, vehicle operation, and other suggested training specified for the project.

The sub-criteria that will be used to evaluate this section are as follow:

1. The extent to which the application will provide information and data to help DOE focus its activities in education.
2. The adequacy of the proposed education plan for the region
3. Commitment of the team to provide support and coordinate with national and international hydrogen outreach programs.
4. Appropriateness of the various products and events that will assist in educating the public about the hydrogen economy.
5. Adequacy of the training program to assure consistent, safe operations and maintenance of the site facilities and vehicles.

APPENDIX A

Statement of Objectives
Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project

A.1.0 Background

The use of fuel cell technology with hydrogen as the energy carrier offers the United States a viable option to reduce dependence on imported petroleum, develop domestic resources, and improve fuel efficiency while reducing greenhouse gas emissions, and enhancing our options for a diverse source of energy feedstocks. It also offers the opportunity to seek system solutions that embrace both transportation and electric generation sectors.

In November of 2002, Energy Secretary, Spencer Abraham, announced the *National Hydrogen Energy Roadmap*, a document designed to ensure a more secure and cleaner energy future for America. The Roadmap provides a blueprint for the coordinated, long-term, public and private efforts required for hydrogen energy development. These requirements include:

- Improved fuel cell durability
- Decreased cost of fuel cell stack
- Enhanced infrastructure/vehicle systems integration
- Focused demonstrations to showcase vehicle/infrastructure capabilities
- Accelerated development of codes and standards
- Public policies to educate the public about hydrogen as a fuel

The Validation project is a government/industry partnership created to address the national challenge of ensuring reliable, domestic, diverse energy sources while reducing U.S. dependence on foreign oil and protecting the environment. The project is based on several documents, including the President's vision for a hydrogen economy discussed in the *National Hydrogen Energy Roadmap* and *Fuel Cells and Hydrogen: the Path Forward*.

A.2.0 Data Objectives

The collection of data for all awarded projects in a standard and consistent manner, while taking into consideration the extensive variety of fuel cell vehicles expected to be used during this project, is a crucial objective. To accomplish this objective, planned fuel cell vehicle testing shall include collection of data as listed in the tables below. We anticipate that this data will contribute to and provide feedback to other R&D programs. The data will also provide plausible justification, through the successful attainment of performance targets, for continued government funding of the future phases necessary to achieve the national objective of hydrogen fuel cell vehicle commercialization.

Data shall be collected to monitor the performance of the vehicles and infrastructure throughout the project period. Applicants shall identify all data that is to be collected and shared, the purpose of the data, and how the information will be used. Tables 1 through 6 list the minimum data sets that shall be collected. Note that parameters included in Table 6 should include 1) the collection of detailed dynamic performance data at both the vehicle and component level; and 2) the development of dynamic driveline vehicle and component simulations and/or data.

A.3.0 Project performance measures

Applicants shall provide summaries of the vehicle, site, and energy parameters, as well as energy production (optional) test plans. Tables 1 - 6 below and the accompanying narrative summarize the performance measures.

A.3.1 Performance Measures

Table 1. Vehicle Performance Measures

Category	Performance Measure	Units	Baseline Benchmark (Current)	2006 Performance Targets	2008 Performance Targets	Comments
Operations	Fuel Economy (a)	MPGGE *	50 (fuel cell vehicle)	50	60	Use draft SAE J2572 and draft EPA fuel economy test procedures. Overall testing may include FTP75, HWYFE, and SCO3 (air conditioning) cycles.
	Range (b)	Miles	170+	200+	300+	Combined weighted average fuel economy from HWYFE and FTP75 (highway and city) cycles in miles/kg, multiplied by capacity of the hydrogen fuel tank in kg (tank capacity is mass of hydrogen in the tank at peak pressure after a fast fill minus mass of hydrogen in the tank at minimum operation pressure).
	Vehicle Refueling Time (c)	Minutes	5	5	5	
Vehicle Fuel Cell Systems	Durability (d)	Hours	500	1000	2000 +	Driving hours between stack overhaul or replacement
	Efficiency (e)	%	25	30	35	Average over FTP cycle (EPA 75)
	H2 Vehicle Tank Cycle Life (f)	Cycles	No Data	500	750	Refueling from ¼ tank to full tank represents one cycle

	Hydrogen Vehicle Tank Durability (g)	Miles	15,000	75,000	170,000	Driving miles between tank and fuel system components overhaul or replacement
Performance	Top Speed (h)	MPH	75+	85+	85+	
	Acceleration (i)	seconds	15	10	8	Time from 0 to 60 mph
	Gradability (j)	% grade		6	6	Achieved at 75 mph
	Minimum Operating Temp (k)	Degrees C	+10	+5	-20	Ambient Temperature over a 30 minute period
	Maximum Operating Temp (l)	Degrees C	No Data	+35	+40	Ambient Temperature with full sun exposure over a 30 minute period
	Cold Drive-Away Time (m)	Seconds	<15	10	5	Measured at +20 degrees C ambient
	Emissions, H2 FCV (n)	g/mi	Zero	Zero	Zero	
Safety	Unplanned Failures	#/1000				
	Fuel Tank Release	#/1000	1	1	0	Measured at PRD during filling
	Grounding Alarm	#/1000	2	1	0	Measured during filling
	Sensor Alarm	#/1000	3	1	1	Measured during maintenance
	Passenger Compartment Alarm	#/1000	1	0	0	Measured during operation

*The equivalence of hydrogen should be based on equivalent heating value of hydrogen and gasoline (nominally 120,000 BTU/gal)

Vehicle Performance Measures—-Definitions
Unless otherwise stated, each applicant shall design a test plan incorporating the vehicle performance measures listed in Table 1 above. The data from this plan will be used to confirm the validity of the SAE voluntary standards for vehicle systems. This includes vehicle safety (J 2758), fuel systems (J 2579), fuel cell system performance (J 2615) and fuel cell stack (J2617) and emissions and fuel consumption (J 2572). The test plan shall be reported annually for each vehicle model. The awardee may use the EPA-NVFEL facility in Ann Arbor, MI or an

equivalent test facility. The government will review and approve testing procedures and the test facility prior to the start of testing.

a) Fuel Economy: For at least one vehicle of each model/drive train type, in each geographic area, conduct the following standardized tests per the draft SAE J2572 standards and draft U.S. EPA fuel cell and hydrogen vehicle test procedures which will include FTP75, HwFET and SCO3.
   - For hybrid electric fuel cell vehicles, provide access to the data acquisition system for current to and from
     - the on-vehicle hybrid electric storage system;
     - the fuel cell; and,
     - from regenerative braking (if applicable)

     to allow calculation of corrected fuel economy as per draft SAE procedures for fuel cell vehicles and draft U.S. EPA procedures for correction of vehicle fuel economy for the effects of regenerative braking and on-vehicle storage of energy.
   - Dynamometer testing over the Federal Test Procedure EPA 75, the Highway Fuel Economy Driving Schedule (HwFET), and the Air Conditioning Supplemental FTP (SCO3) drive cycles as described in Title 40 of the U.S. Code of Federal Regulations, Part 86, Subpart B.
   - Re-test one of each type vehicle in each geographic area every six months using the EPA_NVFEL chassis dynamometer test facility, or a facility that the applicant demonstrates is equivalent to the EPA NVFEL test facility, subject to government approval.
   - For all vehicles fueled with compressed hydrogen, provide a means to temporarily fuel the vehicle from an external compressed hydrogen source during dynamometer testing. The external compressed hydrogen source will be regulated to the flow and pressure specifications provided by the manufacturer. The vehicle connection to the external compressed hydrogen source shall be designed in a manner that interrupts hydrogen flow from the vehicle's internal tank. The vehicle shall be delivered for dynamometer testing with no more than 200 standard cubic feet of hydrogen contained within any on-vehicle storage.
b) Range: For each vehicle, using fuel economy data and the vehicle tank capacity, calculate vehicle range and report on a monthly and per thousand miles driven basis.
c) Vehicle Refueling Time: For each type of vehicle tank, record time to refuel, kg of hydrogen delivered and refueling station conditions, including temperature, pressure and flow rate.
d) Vehicle Fuel Cell System Durability (measured in hours): For each generation of fuel cell vehicle, record the hours driven between major stack overhaul or stack replacement to support claims of stack life and durability.
e) Vehicle Fuel Cell System Efficiency: System efficiency is calculated by dividing the energy required to power the vehicle by the energy consumed by the fuel cell system, measured during a standard EPA 75 FTP driving cycle. (Efficiency = kJ of traction output energy /kJ of energy consumed by fuel cell system x 100). Energy storage and regenerative braking need to be taken into account when calculating efficiency.
f) Hydrogen Vehicle Tank Cycle Life: Fuel tanks installed in these vehicles will conform to CSA/NGV2 published standard for hydrogen storage. Provide information from tank manufacturer to confirm the tank cycle life for each vehicle make and model. In addition, the

number of times the vehicle is refueled, rate or time of fill, and whether the Pressure Relief Device opened shall be recorded.

g) Hydrogen Vehicle Tank Durability: The life of the fuel tank as measured in miles driven between tank replacements or tank overhaul. Applicant will report against standard J2601on the performance of fueling communication devices to ensure adequate safety.
h) Top Speed: Measured in miles per hour, this is a minimum speed expected for acceptable vehicle performance.
i) Acceleration: Provide acceleration data for each vehicle model 60 days after vehicle delivery and for each new model. Continue providing acceleration data every 6 months per vehicle model.
j) Gradability: Provide gradability data for each vehicle model 60 days after vehicle delivery and for each new model every 6 months per vehicle model.
k) Minimum Operating Temperature: Assure acceptable vehicle operations at plus 5 degrees Celsius in 2006 and minus 20 degrees Celsius in 2008. Vehicles must be driven continuously over a thirty-minute period at these stated temperatures.
l) Maximum Operating Temperature: Assure acceptable vehicle operations at plus 35 degrees Celsius in 2006 and plus 40 degrees Celsius in 2008. These tests shall be conducted in full sun exposure to simulate normal black-top parking conditions. Vehicles must be driven continuously over a thirty-minute period at these stated temperatures.
m) Cold Drive-Away Time: The amount of time, measured in seconds and at ambient temperature, to operate the vehicle from a parked position to a full functional, driving mode.
n) Emissions, H2 Fuel Cell Vehicle: None required.
o) Safety: Current regulations will not prohibit any testing of these vehicles under the conditions outlined under this solicitation. All of the data collected will be submitted to DOT/NHTSA for consideration in their adoption as a regulation.

Table 2. INFRASTRUCTURE PERFORMANCE MEASURES

Category	Performance Measure	Units	Baseline Benchmark (Current)	2006 Perform. Targets	2008 Perform. Targets	Comments
SITE						
	Purity of Hydrogen From Infrastructure Storage Tank (a)	% (dry)	99.9	99.9	99.9	Measure against TC197 WG on hydrogen purity.
Fueling System	Durability (b)	Years	No Data	15	18	Service life of major equipment and components excluding storage tanks
	On-Site Hydrogen Production and Delivery Efficiency (c)	%		50	70	Calculated from energy source to H2 in the vehicle storage tank
	Refueling Rate (d)	kg H2/min	No Data	1	1	Rate for on-site (fast fill) refueling station
	Capacity (Fast Fill) (e)	Number of Vehicles		5+ (back to back)	2 (in parallel)	In 2006, capacity to fuel a fleet of 50 vehicles; In 2008 capacity to fuel a fleet up to 100 vehicles
Safety (f)	Release of hydrogen	Vol % H2				Number of alarms

	from fueling connector					
	Nozzle tears/ attached	Number of vehicles				Replacement rate of connectors
	Flares	IR signature				Facility shutdown and alarm
	Building Alarm	Vol % H2				Facility shutdown and alarm
OPTIONAL						
Fuel Cell Co-Generation Facility	Cost of Co-Generation Facility (g)	$/kW of electrical capacity	5,000	2,500	1,500	Installed cost of stationary power generation facility
	Actual Power Fuel Cell Durability (h)	hours		5000 +	20,000+	Operating hours prior to stack replacement
	Electrical Efficiency of Fuel Cells (i)	%		33	35	Heat rate based on lower heating value of natural gas.
Safety (j)	Electrical Overload	Phase variance				Main disconnect failure or fuse burnout
	Ground short	Ohms/ ground				High impedance alarm
	Alarms	Hydrogen release				Facility shutdown and alarm

Infrastructure Performance Measures—Definitions

a) Purity of Hydrogen From Hydrogen Storage Tank: Monitor hydrogen gas quality from the storage tank on a quarterly basis.
b) Fueling System Durability: Based on information supplied by the manufacturers, project the expected life of the fueling system including valving, gauges, piping, and on-site pressure

storage tanks for 2006 and 2008. By 2008, it is anticipated that a 20% improvement in service life for the limiting components will be realized. Both of these performance targets may be modeled and do not require hardware modifications.

c) On-Site Hydrogen Production and Delivery Efficiency: If hydrogen gas is produced on-site by reforming natural gas or other hydrocarbon fuel or if electrolysis is used, prepare an energy budget for the process from source (feedstock) to vehicle storage tank. Monitor the performance against the process budget developed during the design phase monthly and report results quarterly as energy consumed divided by energy value of the hydrogen produced.

d) Refueling Rate: The capability of the on-site refueling system (from storage tank to receiving tank on the vehicle) shall be tested to determine the hydrogen flow rate.

e) Fast Fill Capacity: The station must have the ability to fast fill five or more vehicles one immediately after the other. The station must have the capacity to fill a total of 50 vehicles in a one-day period (24 hours) by 2006. By 2008, the station must demonstrate the capability to fill vehicles in parallel, with a capacity to fill a total of 100 vehicles in a one-day period (24 hours).

f) Safety: Record the number and type of alarms during hydrogen production, delivery, transfer, and vehicular filling. The station must be supplied with redundant alarms based on two different technologies to cover each predicted failure that would result in a hydrogen release.

g) Optional Cost of Fuel Cell Co-generation Facility: Provide data that supports fuel cell costs when built in quantities of 100/year.

h) Actual Fuel Cell Durability: Record hours of fuel cell generator operation, kW-hrs produced, and shutdowns/startups of the power generation system. Summarize data monthly and include results in the quarterly report.

i) Electrical Efficiency of Fuel Cells: Measure the electric efficiency based on input fuel and AC power out. Report the results quarterly and include changes in the system components designed to improve efficiency.

j) Safety: Measure the electrical variance over time and load from the fuel cell and any fluctuation resulting from fuel input variables.

Table 3. Energy Performance Measures

Category	Performance Measure	Units	Baseline Benchmark (Current)	2006 Performance Targets	2008 Performance Targets	Comments
ENERGY						
	Fuel Cost; On-site Production (a)	$/kg of H2	4.50 (CH4)	3.60	3.00	Pre-tax cost of hydrogen at the refueling pump
	Fuel Cost; Off-site Production, if used (b)	$/kg of H2	3.00 (g) 5.00 (L)			Pre-tax cost of H2 from liquid or gaseous H2 including on-site costs at the refueling pump (when produced in quantity)
	Distribution Costs for Off-Site Production Only (c)	$/kg	No Data	TBD	TBD	
Safety	Release of hydrogen during transport and filling	Vol %				Verify delivery systems properly to avoid uncontrolled fuel release
	Infra-red alarm	#/1000	2	1		False alarms due to sensing errors or line of sight

Energy Performance Measures—Definitions

a) Fuel Cost (onsite production): For each on-site system provided (reformer or electrolysis unit) estimate the cost of hydrogen ($/kg) delivered to the vehicle based on the capital, operating, and maintenance costs of all components from the natural gas line or water supply line coming in to the site to the dispenser nozzle at the fueling station. Monitor the costs on an ongoing basis and report actual costs vs. the design basis on a six-month basis. Indicate any system changes made and their potential impact on system performance. Every two years estimate the fuel costs for a reformer or electrolysis system operated at the expected design capacity of a current high volume gasoline station. Additional consideration will be given to those applicants proposing purchase of renewable energy sources such as wind-powered energy supplying the electrical grid.

b) Fuel cost (offsite production) (if used): As stated in the above example but for liquid or gaseous hydrogen delivered to the site by tanker or pipeline. Costs to include production of the hydrogen, compression, and the onsite costs required to deliver to the vehicles.
c) Distribution Costs for Off-Site Production Only: For each shipment, report the delivered cost of the liquid or gaseous hydrogen into the site storage tank. Compare this cost with the delivered cost to the bulk supply source. The difference is the distribution cost.

Table 4. General Data—Vehicles

Vehicles		Comments
	Parameters for Inclusion	Include Date and Time with every parameter
Driver's Log (a)	Miles Driven	Beginning mileage and final mileage after each trip
	Kg of hydrogen	Per fill-up
	Outside ambient temperature	Degrees Celsius at beginning of trip
	Vehicle failures	Log dashboard warning lights
	Vehicle Accidents	
	Other	
Scheduled Maintenance Log (b)	Activities	Show frequency and hours to complete
	Replaced or repaired parts	Include hardware, parts, fluids
	Part Replacement Cost	
	Labor hours for maintenance	
	Labor Cost	
	Total Cost	Includes labor and all parts
Un-Scheduled Maintenance Log (c)	Replaced or repaired parts	Include hardware, parts, fluids
	Part Replacement Cost	
	Labor hours	
	Labor cost	
	Total cost	Includes labor and all parts

General data on Vehicles —Definitions

a) Driver's Log: A daily log of the driver's trip notes listing the parameters given in Table 4 above. List any vehicle performance issues/trends and other issues which the driver/fleet operator might consider relevant.
b) Scheduled Maintenance Log: Include notes from the mechanic regarding any observations made during the vehicle checks.
c) Unscheduled Maintenance and Repair Log: Include notes from the mechanic regarding any observations made during the vehicle repairs.

Table 5. –General Data—Infrastructure

Infrastructure		Comments
	Parameters for Inclusion	Include Date and Time with every parameter
Infrastructure Site Managers Log (a)	Vehicle Refueling	Daily number of refuelings. Daily amount of hydrogen dispensed.
	Tank Refueling	Amount of hydrogen produced or delivered
	Tank Storage	Amount of hydrogen in the storage tank(s) at the end of each day
	Accident or near miss events	
	Safety drills	
	Alarm events	Record cause and result of each event
	Training classes	
	Public meetings	
Scheduled Maintenance Log (b)	Activities	Show frequency and hours to complete
	Replaced or repaired parts and materials	Include hardware, parts, materials
	Parts/materials Replacement Cost	
	Labor hours for maintenance	
	Labor Cost	
	Total Cost	Includes labor and all parts
Unscheduled Maintenance Log (c)	Replaced or repaired parts and materials	Include hardware, parts, materials
	Parts/materials Replacement Cost	
	Labor hours	
	Labor cost	
	Total cost	Includes labor and all parts
	Dispenser failures	
Reformer Unit Performance Log (d)	Monitor unit performance	Daily record of operations.
	Hours of operation	
	Hydrogen produced	
	Feedstock supply	Methane or other fuel supply
	Energy consumed	Per ton of hydrogen produced
	Waste gas emissions	
	Type and amount of pollutant	Per ton of hydrogen produced
	Conversion efficiency	
	Hydrogen produced	
Electrolysis Unit	Monitor unit performance	Daily record of operations

Performance Log (e)		
	Hours of operation	
	Hydrogen produced	Per kW-hr of energy consumed
	Energy consumed	Per ton of hydrogen produced
	Water consumed	Per ton of hydrogen produced
	Water pretreatment	Chemical requirements
	Waste products produced	Type and amount per ton of hydrogen produced
Gas Compression and Storage (f)	Monitor unit performance	Daily record of on-site distribution and storage systems
	Hours of operation	
	Energy consumed	KW-hr of energy consumed per ton of hydrogen compressed
	Amount of Hydrogen compressed	
	Gas flow rate	
Hydrogen Refueling System (g)	Monitor energy use, hours of operation, fuel delivered and system pressure.	Daily record of operations
	Hours of operation	
	System pressure	
	Energy consumed	Per ton of hydrogen delivered
	Amount of hydrogen delivered to vehicles	Daily
	Amount of hydrogen vented	Daily
	Operator time	

General Data on Infrastructure—Definitions

a) Infrastructure Site Manager's Log: A daily log of the site manager's operational notes listing the parameters given in Table 5 above. List any site/facility performance issues/trends considered relevant.
b) Scheduled Maintenance Log: On a daily basis, record all scheduled maintenance for the infrastructure process units and provide notes/comments from the facility engineer (or applicable personnel) regarding observations made during maintenance.
c) Unscheduled Maintenance and Repairs Log: On a daily basis, record all unscheduled maintenance for the infrastructure process units and provide notes/comments from the facility engineer (or applicable personnel) regarding observations made during unscheduled maintenance.
d) Reformer Unit Performance: Record information on a daily basis and summarize data on a weekly basis.
e) Electrolysis Unit Performance: Record information on a daily basis and summarize data on a weekly basis.

f) Gas Compression and Storage: Summarize the data weekly to show the kW-hr of energy consumed per ton of hydrogen compressed.
g) Hydrogen Refueling System: Monitor the recompression/cooling energy required to maintain system pressure (if any). Summarize all data on a weekly basis.

Table 6. –Data for Modeling and Evaluation of Component Development Program at DOE

Vehicle Component	Required Data	Comments
Dynamometer Testing (a)		
Fuel Cell Stack	1. Stack voltage, current 2. Anode inlet and outlet temperature and pressure 3. Cathode inlet and outlet temperature and pressure 4. Hydrogen feed and recirculation rates 5. Cathode air feed rate 6. Humidification levels for cathode and anode feed gases	Data to be obtained on a continuous basis.
Fuel Cell System Balance-of-Plant	1. Power consumption by – air compressor or blower – radiator/condenser fan(s) – hydrogen recirculator – coolant / water pump(s) – any other electrical components 2. Make-up water (if any)	Same as above
Major Components	1. Traction Inverter Motor (TIM) – current, voltage, power in – motor voltage, current, power in – motor shaft power out 2. For hybrid systems – energy storage current and voltage in / out – energy storage thermal management data – regenerative braking current and voltage in / out	Same as above
In-use vehicle performance data from the on-board computer data acquisition system (b, c)		
	1. On/off events 2. Vehicle speed 3. Vehicle mileage 4. Ambient temperature 5. Anode inlet and outlet coolant temperature 6. Cathode inlet and outlet coolant temperature 7. Loggable vehicle power 8. Monitoring of vehicle HVAC 9. All other acquired data that vehicle manufacturer agrees to provide to DOE	
Final Analysis (d)	Vehicle performance at the end of the field studies	Share observations and lessons learned

a) Use draft SAE J2572 and draft EPA fuel economy test procedures. (Overall testing may include FTP75, HwFET and SC03 (air conditioning) cycles). One vehicle of each vehicle type, in each geographic region, to be tested every 6 months.

b) As part of the data gathering program, it is anticipated that vehicle manufacturers will install and maintain on-board computer data acquisition systems as well as systems to assess vehicle performance capabilities during maintenance periods. The government has developed sophisticated software program modeling programs for hydrogen fuel cell vehicles and expects to use these tools to internally analyze and evaluate performance of the different vehicle generations.
c) Vehicle manufacturers to provide the listed information for at least one vehicle of each vehicle type, of each generation, and in each geographic area. Information can be made available via a link to a standard vehicle CAN-BUS connection. If the data are considered proprietary and confidential, it will be treated as such by DOE. The results of performance testing done in the maintenance garage and/or motor test centers will be provided to DOE within ten working days of the testing.
d) Prior to releasing a test vehicle from the program it shall undergo final testing to determine the performance characteristics of the vehicle for comparison with its initial characteristics. Observations and lessons learned from the test program shall be discussed with DOE and included in the appropriate quarterly report. If fuel cell stacks or other major components fail in operation, the manufacturer shall perform post failure analyses, and the analysis results shall be shared with DOE. Information that is considered proprietary and/or confidential will be treated as such by DOE.

A.4.0 Objectives

This project shall proceed over a period of five years, with formal reviews twice per year that includes a presentation at the Hydrogen, Fuel Cell and Infrastructure Technology annual review, with the option of additional quarterly site visits to assess progress and interim results. The objectives are defined in order to assist applicants in structuring their applications; it is not intended to restrict new concepts and diverse approaches that organizations may want to make to address the hydrogen vehicle and infrastructure issues.

Hydrogen-Powered Vehicles. The applicant will provide hydrogen-powered fuel cell vehicles over a 5-year period.

- Only 100% hydrogen-powered vehicles will be accepted;
- A maximum of 50 hydrogen-powered fuel cell vehicles will be accepted per vehicle manufacturer;
- Leased vehicles are preferred over purchased vehicles and leases for 2 to 3 years are encouraged for each vehicle; and,
- Vehicles from the following categories will be considered:
    - light duty vehicles (LDV) such as automobiles;
    - light duty trucks (LDT) and medium duty passenger vehicles (MDPV) such as SUVs, light trucks and vans;
    - light and medium heavy duty trucks such as large passenger vans and urban delivery trucks.

Hydrogen ICE vehicles in generation 1 can be considered where it can contribute to advanced storage system development, advanced hydrogen vehicle development (i.e. low-weight, low drag, hybrid platforms) and/or advanced fueling interface and safety devices for generation 2 fuel cell vehicles.

Hydrogen Infrastructure. The definition of infrastructure includes hydrogen production and/or delivery, hydrogen storage, the refueling system, and any associated land, buildings or other civil/structural facilities required. The guidelines include:

- Agreements will be awarded for one to three regions;
- At least one hydrogen production system must use renewable feedstocks;
- Fossil feedstocks are acceptable;
- A vehicle maintenance facility must be at the site location;
- State, federal, military or industrial facilities may be utilized, however, costs associated with federal personnel or federal facilities would be considered part of the federal government cost contribution.

The application must include all region(s) of interest. DOE seeks to allow maximum flexibility to applicants at the application stage of the project and will evaluate bids based on the technical merit, project feasibility, safety and health, the education and training plan, and the performance data plan as discussed in the solicitation.

A.5.0 Tasks

The following major tasks are listed as guidance and represent the minimum scope of work expected from applicants. Applicants should prepare their work tasks as a five-year project.

The applicant shall provide proposed tasks based on the material presented in this document with a milestone schedule showing major decision points. The proposed tasks listed below should be the basis for the project scheduling and budgeting documents. Each applicant may add subtasks, or additional tasks as needed.

Tasks have been broken into four categories (Hydrogen-Powered Vehicles, Hydrogen Infrastructure, Optional Co-production Facilities, and Other Tasks) to be used as guidance in preparing the data acquisition portion of the application.

A.5.1 Hydrogen-Powered Vehicles

Vehicle Tasks:

1. Vehicle Planning, Scheduling, and Delivery

The applicant shall provide a preliminary plan that includes vehicle specifications, delivery schedule, operation schedule, and cost share percentage in their application. The initial and subsequent vehicle deliveries, type, and number of vehicles should be considered to be major milestones. The vehicle delivery plan will be updated at least twice yearly as the project advances. DOE must agree to new funding requirements of the updated plans before any changes are approved.

2. Vehicle Systems Startup

The applicant shall provide training and startup of the vehicle systems. The applicant will prepare a training program that includes health and safety instructions and detailed instructions for data collection procedures prior to vehicle system startup. The training program will be reviewed with DOE and documented in a task report.

3. Vehicle Operation and Maintenance

The applicant shall describe how the fleet operator and the vehicle supplier(s) will operate and maintain vehicles. A testing plan that includes DOE objectives and lists any additional OEM objectives shall be provided to measure and evaluate vehicle performance, durability, and reliability characteristics, the specifics of which are listed in Section 2 of this Appendix.

4. Vehicle Data Collection and Reporting

Data generation, collection, and evaluation must be outlined in a data collection plan. The applicant shall assess data and provide results that demonstrate how the system is performing relative to the Performance Measures and specifications. The applicant shall develop and maintain a database and use necessary modeling tools to estimate performance and cost.

The (minimum) data collection and reporting requirements for vehicles are located in Table 1 of the SOW. A list of any additional data that will be made available should be added to the required list in order to strengthen the rating of the application.

It is understood that participants may develop their own or additional measures and criteria for technical and business decisions. DOE will consolidate data regularly to evaluate performance and trends for the broader DOE Hydrogen, Fuel Cells & Infrastructure Technologies Program. Issues related to protection and use of proprietary data shall be negotiated and agreed upon by all parties prior to award.

The applicant shall provide requested data for a life cycle assessment (LCA) for each project awarded. The "well-to-wheels" assessment shall examine environmental impacts and cost for the overall system.

Data shall be reported in a series of quarterly technical reports. Data for the project shall be compiled and documented annually and in the final project report.

5. Vehicle Codes and Standards

Each team will work with local jurisdictions to apply Model Building Codes adopted for the design, construction and operation of hydrogen fueling stations and the relevant SAE standards for the operation and maintenance of hydrogen vehicles. Vehicle suppliers, infrastructure developers, appropriate standards development organizations and regulators, and other pertinent participants should be included in discussions of codes and standards. An appropriate detailed plan outline for codes and standards that apply shall be included with the application and must be developed in the first nine months of the program.

6. Safety Plan

The applicant shall prepare a detailed plan within 30 days of award for review by the DOE Safety Panel. A second safety plan for the systems operation will be due 60 days prior to the startup of systems operations. Both of these plans will be prepared in accordance with the Program Safety guidance document provided at time of award. Updates/revisions to the plan(s) shall be made periodically, but not less than once per year. The task shall include preparation of "lessons learned" documentation.

7. Vehicle Maintenance Facility Engineering, Permitting, and Construction

The applicant shall provide an engineering package including calculations and sketches showing the requirements for the vehicle maintenance facility. Actual permitting, location on the selected site, final design and construction shall be accomplished in conjunction with other similar facilities as determined by the site team/project manager. The site arrangement and design shall be reviewed by DOE within 60 days. The ability of DOE and DOE contractor personnel to visit the maintenance facility shall be specified.

A.5.2 Hydrogen Infrastructure

Tasks:

1. Hydrogen Infrastructure Engineering, Permitting, and Construction

The availability of a committed site(s) and fleet contractor must be confirmed before the initial application screening. The applicant shall provide an engineering package including a site map, drawings and calculations, a schedule, and the budget required for permitting and construction of the hydrogen infrastructure facilities. The plans will be reviewed by DOE within 60 days. Upon approval, the applicant shall engineer and install the necessary facilities.

If liquid and/or gaseous hydrogen are delivered to the site(s) rather than produced at the site, the applicant shall provide completed engineering, permitting, and construction documentation for the proposed system.

2. Infrastructure Systems Startup

The applicant shall provide a training and startup plan for the hydrogen infrastructure systems including hydrogen production/delivery, hydrogen storage, refueling, and other requirements/facilities. The applicant shall prepare a training program and detailed instructions for data collection procedures.

3. Infrastructure Operation and Maintenance

The applicant shall conduct infrastructure operation and maintenance over the project life (minimum of five years) and provide a testing plan that reflects the objectives listed in Section 2 of this Appendix as well as any additional DOE goals that are negotiated. The testing plan will measure and evaluate performance, durability, and reliability characteristics. Hydrogen production, transport, storage, and refueling must be addressed.

4. Infrastructure Codes and Standards

Each site team is to work with the project manager's codes and standards specialists and pertinent agencies to develop and apply codes and standards for the design, engineering, installation, and operation of hydrogen vehicles and infrastructure. Discussions concerning codes and standards issues should include vehicle suppliers, infrastructure developers, appropriate standards development organizations, regulators and other pertinent participants. These discussions should be ongoing and coordinated with federal representatives. An appropriate plan outline for the codes and standards shall be included with the application.

5. Infrastructure Data Collection and Reporting

The applicant shall assess data and compare the results to the table in Section 2 of this Appendix. The applicant shall develop and maintain a database and use necessary modeling tools to estimate performance and cost.

The data collection (Table 2) and reporting requirements (Table 8) for infrastructure are located in the SOO. Additional data that will be made available should be added to the required list to strengthen the rating of the application.

Teams may develop their own measures and criteria for technical and business decisions. DOE will consolidate data regularly to evaluate performance and trends for the broader Hydrogen Fuel Cell and Infrastructure Technology Program.

The applicant shall prepare data for a life cycle assessment (LCA) for their project as part of the year 2006 and year 2008 (final) report. The "well-to-wheels" assessment shall examine environmental impacts and costs for the overall hydrogen system.

Data shall be reported in a series of quarterly technical reports. Data for the project shall be compiled and documented annually as well as in the final project report.

A.5.3 Optional Co-production Facilities
The program plan should include the construction, siting, and operation of a prototype unit that will validate the ability to meet the required performance measures for a network. This must be accomplished prior to proceeding with the production of 7.5MW of fuel cells for the network.

1. Co-production Facility Engineering, Permitting and Construction
The availability of a committed site(s) must be confirmed before the initial proposal screening. The applicant shall provide a deployment plan for a co-production facility that includes the permitting strategy and how facilities will be later expanded to provide hydrogen for increasing numbers of vehicles. Include a rationale of how this system will promote a facility network.

Each site team is to work with the project manager's codes and standards specialists and pertinent agencies to identify and implement appropriate safety and engineering controls in the design, installation, and operation of a co-production facility. Discussions concerning codes and standards issues should include vehicle suppliers, infrastructure developers, appropriate standards development organizations, code officials, regulators and other pertinent participants. These discussions should be ongoing and coordinated with federal representatives. An appropriate safety plan outline shall be included with the proposal.

2. Co-production Facility Operation and Maintenance
The applicant shall describe the operation and maintenance philosophy of the network operation and must show how the facility will be transitioned from prototype to mass production. The manufacturing line capabilities shall be outlined and include plans for micro-grid interfacing.

3. Co-production Facility Data Collection and Reporting
The applicant shall assess data and develop and maintain a database and use necessary modeling tools to estimate performance and cost.

The minimum data collection and reporting requirements for the co-production facility are located in Table 2 of the SOO. Additional parameters should be added, as needed.

Data requirements and reporting shall be the same as for other portions of the project.

A.5.4 Other Tasks

1. Hydrogen Systems Integration

The applicant shall identify, define, and prioritize technical issues between vehicle and infrastructure components requiring resolution for successful project initiation and operation. Recommendations for better integration of components shall be documented. Reported information will be compiled and used as a guideline for systems integration of vehicles and infrastructure.

2. Education and Training

The applicant shall prepare a local/regional plan to increase the general knowledge of hydrogen vehicles and facilities and their uses. The applicant shall provide materials for education and training, including materials suited for use on the Internet. As part of project review meetings, the applicant shall report actions and progress on education and training tasks, and recommend future actions for implementation.

3. Life Cycle Assessment (LCA)

The applicant will conduct a Life Cycle Assessment (LCA) using ISO 14040 standards and including the associated review requirements. DOE will identify the review panel members.

A.6.0 Review Meetings

An initial "kick-off" meeting will be held within 30 days following award. Quarterly reviews shall be scheduled at each site on a rotating basis for the first two years of the project. In following years, twice-per-year review meetings and a final review meeting shall be conducted on a rotating site basis.

A.7.0 Deliverables

For scheduling and budgeting, a project start-date of March, 2004, may be assumed. The project duration is expected to be (no more than) 5 years. Deliverables shall be per DOE requirements and shall include major scheduled milestones. The reports listed in Appendix A Section 8 shall be included as deliverables.

A.8.0 Reporting Requirements

The following reports are required:

Deliverable	**Frequency**
Project Management Plan	90 days after award with annual updates
Startup Lessons Learned	Annual
Annual Test and Data Collection Plan	90 days after award with annual updates
Vehicle and Facility Training Plan	90 days after award with annual updates
Technical Progress Report, to include reporting and analysis of raw data (see Note 1 below)	Quarterly (One progress report is satisfied by a presentation at the Annual Review Meeting)
Topical Reports (see Note 2 below) Must include: 1. Economic and commercial viability of vehicles at 500K units/year 2. Economic and commercial viability of refueling stations at 1000 refueling stations/year.	As scheduled in the work plan Every two years Every two years
Safety Plan	90 days after award with annual updates
Failure Modes and Effects Analysis	Initial with the application and update annually with new data
Risk Mitigation Plan	90 days after award with annual updates
Communication Plan	90 days after award with annual updates
Cost Reports	Monthly
Plans and schedules for vehicle delivery and/or facility installations	As needed
Design packages for maintaining garage and other hydrogen facilities	As needed
Final Technical Report (see Note 3 below)	Once, at project conclusion

Notes

1) TECHNICAL PROGRESS REPORT (QUARTERLY): The body of the report shall contain a full account of progress, problems encountered, plans for the next reporting period, and an assessment of the prospects for future progress. The Technical Progress Report shall include sufficient detail to allow the work to be reproduced by others. Results and reduced data shall be presented. When systems and/or procedures

are reported for the first time, they shall be described in detail. This description shall contain detailed information on equipment and procedures utilized and the rationale for their use. All data reduction and transformation methods shall be fully documented. For every fourth calendar quarter for quarterly reports, the report should be expanded to provide detailed information and assessment of the results of the past year, problems encountered, and significant accomplishments. The annual report shall also include a list of publications and presentations, and shall include activities to be taken the following year. One progress report is satisfied by a presentation at the Annual Review Meeting.

2) TOPICAL REPORTS: These reports provide a comprehensive statement of the technical results of the work performed for a specific task or subtask, or detail significant new scientific or technical advances. Reports will include economic and commercial viability of hydrogen fuel cell vehicles and refueling stations.

3) FINAL TECHNICAL REPORT (at project conclusion): The Final Report shall document and summarize all work performed during the award period in a comprehensive manner. It shall also present findings and/or conclusions drawn from this work. This report shall not merely be a compilation of information contained in subsequent quarterly, or topical reports, but shall present information in an integrated fashion, and shall be augmented with findings and conclusions drawn from the test and Validation project as a whole.

Abbreviations and Glossary

Codes and Standards – Rules, regulations, and accepted performance criteria governing the design, installation, operation, and maintenance of (in this case) the hydrogen fuel cell vehicles and infrastructure.

Controlled Fleet Operation – The commercial or government use of vehicles as part of business operations.

Deliverable – A product defined in the application to be prepared and provided to DOE. Deliverables are the basis of schedule and budget estimates and project monitoring and control functions.

Energy Company – Those companies that are major distributors of petroleum using large networks to distribute fuel for vehicles.

Fleet Operator of Vehicles – The business operator in charge of a number of fleet vehicles.

Fossil Fuels – Oil and other liquid petroleum products, natural gas, coal and coal derived fuels, and solid fuels derived from petroleum.

g/mile – gram per mile

GGE – Gallon of Gasoline Equivalent

GHG – greenhouse gas

Greenhouse Gas Emissions – Gases known to cause long-term changes to the atmosphere, and possible climate changes or other environmental impacts. For this project, CO_2 is the primary GHG of interest, along with methane, that may be produced in the production or transport of hydrogen.

Hydrogen Infrastructure – Hydrogen supply (production and/or transport and delivery) and storage, vehicle refueling, infrastructure operation and maintenance. Also includes health and safety and public education as part of the project's scope of work.

Hydrogen Vehicles – For this solicitation, automobiles, light trucks, and sport utility vehicles (SUVs) fueled by hydrogen.

ICE – Internal Combustion Engine

Key Personnel – Personnel designated as key to the project, such as the Project Manager. Replacement of key personnel can only be done in consultation with DOE.

kW – Kilowatt

LCA (aka Well-to-wheels) - The life cycle assessment (LCA) is an analytic method for identifying and evaluating the environmental impacts of emissions and resource depletion associated with a specific process. In LCA, material and energy balances are used to quantify the emissions, resource depletion, and energy consumption of all processes required to make the

process of interest operate, including raw material extraction, transportation, processing, and final disposal of products and by-products. The results of this inventory are then used to evaluate the environmental impacts of the process so that efforts can be focused on mitigating negative effects.

Light Truck – Pickups and vans up to ¾ ton.

Merit Criteria – The items selected by DOE and believed most important to the success of the project.

Mobile Power – For the solicitation, mobile power is the hydrogen fuel cell or ICE vehicles proposed for testing.

Non-USCAR entity: All other major OEM auto manufacturers

NREL – National Renewable Energy Laboratory

OEM – Original equipment manufacturer

Program –One or more projects that share common goals and leadership.

Project– All of the facilities, real estate, staff and management team required to deliver the proposed scope at the selected regional site. This may include dispersed facilities within the geographic region selected.

Project Manager – The designated single point of contact for the project, and primary contact for DOE.

Project Team Participant – An industrial, government, or other member of the proposed team.

R&D – Research and Development

Refueling Station – The facilities to replenish hydrogen in the vehicles' storage tanks.

Regions – A geographical region is defined as an area with different climatic conditions. The purpose of using different geographical regions is to prove that hydrogen-powered vehicles can operate throughout the U.S. and can, thereby, offer a national solution to the energy crisis.

Renewable Energy – Energy derived from renewable resources such as wind, solar, hydro, biomass, and geothermal.

Site Manager – The designated individual responsible for the site defined in the application. A site may include a central hydrogen production/storage, refueling, operations and maintenance system, and satellite locations for refueling or other operations.

SOO – Statement of Objectives

Startup – The period of unit/system testing and initial operation between completion of engineering and installation activities.

Stationary Power – For the solicitation, stationary power would be fuel cells generating electric power from hydrogen or other energy sources.

US DOE – United States Department of Energy

USCAR entity: DaimlerChrysler, General Motors, Ford