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TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2		Site Selection
3		CORE-CE5 System Design
4	X	WVO CORE Reformer Fabrication Assembly and Test
5		CORE-CE5 CHP Module Fabrication
6		Integrated CORE CE5 System Assembly
7	X	Integrated WVO CORE CE5 System Testing
8		Integrated CORE CE5 System Final Assembly and Simulated Field Demonstration
9		Integrated CORE CE5 System Field Demonstration
10		System Evaluation
11		Technology Transfer Activities
12		Production Readiness Plan

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1-12	Mehdi Namazian Bill Sproull	CEP	

GLOSSARY

Specific terms and acronyms used throughout this scope of work are defined as follows:

Term/ Acronym	Definition
AB 32	Assembly Bill 32 (2006), the Global Warming Solutions
ABMA	American Boiler Manufacturer Association
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing Materials
BOP	Balance of Plant
Btu	British Thermal Unit
°C	Degrees Celsius
CAD	Computer Aided Design
CARB	California Air Resources Board
CE5	Clear Edge Power 5 kWe
CECOM	Communications-Electronics Command of the Army
CEP	Clear Edge Power
CFD	Computational Fluid Dynamics
CHP	Combined Heat and Power
CO	Carbon Monoxide
CO ₂	Carbon Dioxide

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Term/ Acronym	Definition
CORE	Compact Reliable and Robust Reformer
CORE-CE5	The Project Product Combining CORE and CE5 CHP
CORE-Cogen	CHP The Product Being Developed for the Army
CPR	Critical Project Review
CSA	Canadian Standards Association
DARPA	Defense Advanced Research Projects Agency
DER	Distributed Energy Resources
DG	Distributed Generation
DOD	US Department of Defense
Energy Commission	California Energy Commission
EPA	Environmental Protection Agency
FGR	Flue Gas Recirculation
FP	Fuel Processor
FPP	Fuel Preprocessor
HTPEM	High-Temperature Polymer-Electrolyte Membrane
JP-8	Jet Propellant 8
kWe	Kilowatt-Electric
MMBtu	Million British Thermal Units
MW	Megawatts
NO _x	Mono-Nitrogen Oxides
OFPC	Oil Filtering and Pre-cleaning
OSR	Oil Steam Reforming
PAC	Project Advisory Committee
PIER	Public Interest Energy Research
PM	Particulate Matter
PSU	Penn State University
QA/QC	Quality Assurance/Quality Control
RD&D	Research, Development and Demonstration
RICE	Reciprocating Internal Combustion Engine
SOFC	Solid Oxide Fuel Cell
TARDEC	U.S. Army Tank-Automotive Research, Development and Engineering Center
UNLB	Ultra Low NOx Burner
VOC	Volatile Organic Compounds
WVO	Waste Vegetable Oil

Problem Statement:

There are over 30,000 fast-food establishments in California and 230,000 nationwide. Each year these establishments produce 12 million tons of carbon dioxide (CO₂) in California, and over 89 million tons of CO₂ nationwide. On the other hand, each restaurant also typically produces waste vegetable oil (WVO) that is sufficient to power

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a 4-5 Kilowatt-Electric (kWe) combined heat and power (CHP) system. However, currently there is no CHP that can operate on this waste oil fuel efficiently and meet the California California Air Resources Board (CARB) 2007 emission targets.

The Recipient is currently leading several federally sponsored projects with partners ClearEdge Power (CEP) (Subcontractor), Dewey Electronics, and Penn State University (PSU) in developing high-temperature polymer-electrolyte membrane (HTPEM) fuel-cell power systems that operate on distillate fuels, and this work takes advantages of the expertise and experience that the Recipient and the Subcontractors have developed under these programs, along with the Subcontractor's commercialization efforts for 5-kWe/50,000 – British Thermal Unit (Btu) home CHP systems to synergistically produce a WVO fueled 4-kWe/45,000 – Btu / hour CHP system which is based on the Recipient's reforming technology and the Subcontractor's HTPEM fuel-cell technology.

Further, this work aims to align the cost of the WVO-fueled CHP system to one that facilitates significant market penetration even if the current incentives were to be rescinded. The potential market is large enough to overcome barriers to small-scale distributed generation (DG) technology by a large-scale implementation of small-scale DG technology. The work will produce significant grid reliability and emissions benefits for California ratepayers and the technology addresses the stated intentions of Assembly Bill (AB) 32, the Global Warming Solutions Act ("AB 32") by using a renewable waste stream as a fuel source for a reduction in net CO₂ emissions. Since the California fast-food market is not as large as others, for power generation and CHP, the attractiveness of any potential investment opportunity on the part of private equity firms that typically seek large returns on their investment(s), is not as great as for other markets. This appears to result in a void, in terms of research, for the relatively small fast food market.

Goals of the Agreement:

The goal of this Agreement is to develop, demonstrate, and commercialize a 4-5 kWe WVO driven CHP system, referred to as the project product combining CORE and CE5 CHP (CORE-CE5) with over 80% system efficiency that meets the CARB 2007 emission standards. The system will convert 12 gallons of WVO to produce 100 kWhs electricity daily with an overall efficiency of 80%. The overall system payback period is anticipated to be 7 years with no incentives and 3-5 years with incentives.

The system will use the current natural gas driven Clear Edge Power 5 kWe (CE5) CHP system, manufactured by the Subcontractor, which is a major subcontractor under the effort, as the platform. The CE5 will be integrated with the Recipient's compact reliable and robust reformer (CORE) that converts the waste vegetable oil to a reformat that is suitable for the CE5. The CORE product is based on the Recipient current multi fuel reformer that operates on diesel, jet propellant 8 (JP-8), and biofuels. Under the project the current reformer will be modified to convert the waste cooking oil to a methane-rich reformat that can be fed into the commercial CE5 to produce power and heat. By building upon the current Recipient's reformer and commercially available CE5 platform, the overall technical risk of the project will be low, the system cost will be minimized, and the project goal can be achieved.

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Objectives of the Agreement:

The objectives of this Agreement are to:

- Produce an electricity grid-connectable 4-5 kWe CORE-CE5 CHP system that:
 - Converts 12 gallons WVO to produce 100 kWhs electricity daily.
 - Operates on waste vegetable oil with natural gas as backup fuel.
 - Has over 80% system efficiency.
 - Produces over 4 kWe at an anticipated availability of over 90% and over 40,000 Btu/hr heat and hot water.
 - Produces water at 150 degrees Celsius (°C).
 - Reduces the CORE-CE5 payback by two years over a natural gas driven unit.
 - Meets the CARB 2007 emission standards.
- Prepare a Production Readiness Plan to commercialize the WVO CHP system at a payback period of less than 7 years.

The project uses the current recipient reformer and the subcontractor's fuel cell based CE5 CHP system that currently operates on natural to produce the WVO Driven CORE-CE5 CHP system. The development, fabrication, and demonstration of the CORE-CE5 is a measurable objective that allows producing a CHP product that does not exist currently. The laboratory and field tests planned under the project will provide independent and verifiable data on the system performance. By operating on the waste fuel, instead of natural gas the CORE-CE5 reduces the payback period by two years and significantly enhances the acceptance of CHP into the fast food establishments.

This project's success will facilitate using the renewable waste vegetable oils, at the location where they are produced, and potentially eliminating 1.0 million tons of net CO₂ emissions for which the fast food establishments are currently responsible. It also will result in producing 65 Megawatts (MW) of power using renewable and waste fuel.

Product Guidelines:

For complete product guidelines, refer to Section 5 in the Terms and Conditions.

TASK 1 ADMINISTRATION

Task 1.1 Attend Kick-off Meeting

The goal of this task is to establish the lines of communication and procedures for implementing this Agreement.

The Recipient shall:

- Attend a "Kick-Off" meeting with the Commission Project Manager, the Grants Officer, and a representative of the Accounting Office. The

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Recipient shall bring its Project Manager, Agreement Administrator, Accounting Officer, and others designated by the Commission Project Manager to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the Commission Project Manager will provide an agenda to all potential meeting participants.

The administrative portion of the meeting shall include, but not be limited to, the following:

- Discussion of the terms and conditions of the Agreement
- Discussion of Critical Project Review (Task 1.2)
- Match fund documentation (Task 1.6)
- Permit documentation (Task 1.7)

The technical portion of the meeting shall include, but not be limited to, the following:

- The Commission Project Manager's expectations for accomplishing tasks described in the Scope of Work
- An updated Schedule of Products
- Discussion of Progress Reports (Task 1.4)
- Discussion of Technical Products (Product Guidelines located in Section 5 of the Terms and Conditions)
- Discussion of the Final Report (Task 1.5)

The Commission Project Manager shall:

- Designate the date and location of this meeting.

Recipient Products:

- Updated Schedule of Products (no draft)
- Updated List of Match Funds (no draft)
- Updated List of Permits (no draft)

Commission Project Manager Product:

- Kick-Off Meeting Agenda (no draft)

Task 1.2 Critical Project Review (CPR) Meetings

The goal of this task is to determine if the project should continue to receive Energy Commission funding to complete this Agreement and to identify any needed modifications to the tasks, products, schedule or budget.

CPRs provide the opportunity for frank discussions between the Energy Commission and the Recipient. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Commission Project Manager and as shown in the

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Technical Task List above. However, the Commission Project Manager may schedule additional CPRs as necessary, and any additional costs will be borne by the Recipient.

Participants include the Commission Project Manager and the Recipient and may include the Commission Grants Officer, the Public Interest Energy Research (PIER) Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Commission Project Manager to provide support to the Energy Commission.

The Commission Project Manager shall:

- Determine the location, date, and time of each CPR meeting with the Recipient. These meetings generally take place at the Energy Commission, but they may take place at another location.
- Send the Recipient the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion on both match funding and permits.
- Conduct and make a record of each CPR meeting. One of the outcomes of this meeting will be a schedule for providing the written determination described below.
- Determine whether to continue the project, and if continuing, whether or not modifications are needed to the tasks, schedule, products, and/or budget for the remainder of the Agreement. Modifications to the Agreement may require a formal amendment (please see the Terms and Conditions). If the Commission Project Manager concludes that satisfactory progress is not being made, this conclusion will be referred to the Energy Commission's Research, Development and Demonstration (RD&D) Policy Committee for its concurrence.
- Provide the Recipient with a written determination in accordance with the schedule. The written response may include a requirement for the Recipient to revise one or more product(s) that were included in the CPR.

The Recipient shall:

- Prepare a CPR Report for each CPR that discusses the progress of the Agreement toward achieving its goals and objectives. This report shall include recommendations and conclusions regarding continued work of the projects. This report shall be submitted along with any other products identified in this scope of work. The Recipient shall submit these documents to the Commission Project Manager and any other designated reviewers at least 15 working days in advance of each CPR meeting.
- Present the required information at each CPR meeting and participate in a discussion about the Agreement.

Commission Project Manager Products:

- Agenda and a list of expected participants (no draft)
- Schedule for written determination (no draft)
- Written determination (no draft)

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Recipient Product:

- CPR Report(s) (no draft)

Task 1.3 Final Meeting

The goal of this task is to closeout this Agreement.

The Recipient shall:

- Meet with Energy Commission staff to present the findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement.

This meeting will be attended by, at a minimum, the Recipient, the Commission Grants Office Officer, and the Commission Project Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Commission Project Manager.

The technical portion of the meeting shall present an assessment of the degree to which project and task goals and objectives were achieved, findings, conclusions, recommended next steps (if any) for the Agreement, and recommendations for improvements. The Commission Project Manager will determine the appropriate meeting participants.

The administrative portion of the meeting shall be a discussion with the Commission Project Manager and the Grants Officer about the following Agreement closeout items:

- What to do with any equipment purchased with Energy Commission funds (Options)
- Energy Commission's request for specific "generated" data (not already provided in Agreement products)
- Need to document Recipient's disclosure of "subject inventions" developed under the Agreement
- "Surviving" Agreement provisions, such as repayment provisions and confidential Products
- Final invoicing and release of retention
- Prepare a schedule for completing the closeout activities for this Agreement

Products:

- Written documentation of meeting agreements (no draft)
- Schedule for completing closeout activities (no draft)

Task 1.4 Monthly Progress Reports

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The goal of this task is to periodically verify that satisfactory and continued progress is made towards achieving the research objectives of this Agreement on time and within budget.

The objectives of this task are to summarize activities performed during the reporting period, to identify activities planned for the next reporting period, to identify issues that may affect performance and expenditures, and to form the basis for determining whether invoices are consistent with work performed.

The Recipient shall:

- Prepare a Monthly Progress Report which summarizes all Agreement activities conducted by the Recipient for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the Commission Project Manager within 10 days of the end of the reporting period. The recommended specifications for each progress report are contained in Exhibit A, Attachment A-2.

Product:

- Monthly Progress Reports (no draft)

Task 1.5 Final Report

The goal of the Final Report is to assess the project's success in achieving its goals and objectives, advancing science and technology, and providing energy-related and other benefits to California.

The objectives of the Final Report are to clearly and completely describe the project's purpose, approach, activities performed, results, and advancements in science and technology; to present a public assessment of the success of the project as measured by the degree to which goals and objectives were achieved; to make insightful observations based on results obtained; to draw conclusions; and to make recommendations for further RD&D projects and improvements to the PIER project management processes.

The Final Report shall be a public document. If the Recipient has obtained confidential status from the Energy Commission and will be preparing a confidential version of the Final Report as well, the Recipient shall perform the following activities for both the public and confidential versions of the Final Report.

The Recipient shall:

- Prepare an Outline of the Final Report.
- Prepare a Final Report following the approved outline and the latest version of the PIER Final Report guidelines published on the Energy Commission's website at <http://www.energy.ca.gov/contracts/pier/contractors/index.html> at the

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time the Recipient begins performing this task, unless otherwise instructed in writing by the Commission Project Manager. Instead of the timeframe listed in the Product Guidelines located in Section 5 of the Terms and Conditions, the Commission Project Manager shall provide written comments on the Draft Final Report within fifteen (15) working days of receipt. The Final Report must be completed on or before the end of the Agreement Term.

- Submit one bound copy of the Final Report with the final invoice.

Products:

- Draft Outline of the Final Report
- Final Outline of the Final Report
- Draft Final Report
- Final Report

Task 1.6 Identify and Obtain Matching Funds

The goal of this task is to ensure that the match funds planned for this Agreement are obtained for and applied to this Agreement during the term of this Agreement.

The costs to obtain and document match fund commitments are not reimbursable through this Agreement. Although the PIER budget for this task will be zero dollars, the Recipient may utilize match funds for this task. Match funds shall be spent concurrently or in advance of PIER funds for each task during the term of this Agreement. Match funds must be identified in writing and the associated commitments obtained before the Recipient can incur any costs for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the Commission Project Manager at least 2 working days prior to the kick-off meeting. If no match funds were part of the proposal that led to the Energy Commission awarding this Agreement and none have been identified at the time this Agreement starts, then state such in the letter. If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter a list of the match funds that identifies the:
 - Amount of each cash match fund, its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied
 - Amount of each in-kind contribution, a description, documented market or book value, and its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient shall identify its owner and provide a

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contact name, address and telephone number, and the address where the property is located

- Provide a copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured.
- Discuss match funds and the implications to the Agreement if they are reduced or not obtained as committed, at the kick-off meeting. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide the appropriate information to the Commission Project Manager if during the course of the Agreement additional match funds are received.
- Notify the Commission Project Manager within 10 days if during the course of the Agreement existing match funds are reduced. Reduction in match funds must be approved through a formal amendment to the Agreement and may trigger an additional CPR.

Products:

- A letter regarding match funds or stating that no match funds are provided (no draft)
- Copy(ies) of each match fund commitment letter(s) (if applicable) (no draft)
- Letter(s) for new match funds (if applicable) (no draft)
- Letter that match funds were reduced (if applicable) (no draft)

Task 1.7 Identify and Obtain Required Permits

The goal of this task is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track.

Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement. Although the PIER budget for this task will be zero dollars, the Recipient shall budget match funds for any expected expenditures associated with obtaining permits. Permits must be identified in writing and obtained before the Recipient can make any expenditure for which a permit is required.

The Recipient shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Project Manager at least 2 working days prior to the kick-off meeting. If there are no permits required at the start of this Agreement, then state such in the letter. If it is known at the beginning of the Agreement that permits will be required during the course of the Agreement, provide in the letter:

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- A list of the permits that identifies the:
 - Type of permit
 - Name, address and telephone number of the permitting jurisdictions or lead agencies
- The schedule the Recipient will follow in applying for and obtaining these permits
- Discuss the list of permits and the schedule for obtaining them at the kick-off meeting and develop a timetable for submitting the updated list, schedule and the copies of the permits. The implications to the Agreement if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in the Progress Reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, provide the appropriate information on each permit and an updated schedule to the Commission Project Manager.
- As permits are obtained, send a copy of each approved permit to the Commission Project Manager.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the Commission Project Manager within 10 days. Either of these events may trigger an additional CPR.

Products:

- Letter documenting the permits or stating that no permits are required (no draft)
- A copy of each approved permit (if applicable) (no draft)
- Updated list of permits as they change during the term of the Agreement (if applicable) (no draft)
- Updated schedule for acquiring permits as changes occur during the term of the Agreement (if applicable) (no draft)

TECHNICAL TASKS

TASK 2 SITE SELECTION

The goal of this task is to select a fast food establishment site in California for demonstrating the CORE-CE5 CHP system in the field.

The Recipient shall:

- Contact potential sites.
- Produce a list of potential fast food sites for field testing.
- Visit the high potential sites and secure a host site.
- Negotiate cost.
- Negotiate leave-in-place or return-to-original condition clauses.

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- Create test schedule and obtain all necessary agreements and permits for the retrofit and test of the CHP system.
- Host facility payments and payment schedules on delivered equipment.
- Investigate grid-hookup requirements and charges.
- Draft and execute applicable contracts and indemnification agreements.
- Obtain agreements on test duration, site visits, and other factors.
- Prepare a site selection report that documents the potential sites, selected sites and agreements created under the task.

Products:

- Site list
- Contracts and agreements signed on the site selected
- Draft Site Selection Report
- Final Site Selection Report

TASK 3 CORE-CE5 SYSTEM DESIGN

The goal of this task is to perform detailed engineering analyses of the entire CORE-CE5 system and each component to arrive at design and operating specifications for the performance of the entire system.

The Recipient shall:

- Prepare the list of performance objectives and operational attributes of the CORE-CE5 system.
- Collect sample waste oil from fast food restaurants.
- Analyze the waste vegetable oils from different sites to evaluate their effect on design.
- Perform modeling to produce the system process diagram.
- Define the system energy and mass balance and produce the corresponding diagrams.
- Define modifications to the CORE burner to meet the CARB 2007 goals
- Design CORE-CE5 Oil Filtering and Pre-cleaning (OFPC) components that clean and upgrade the WVO.
- Design the CORE-CE5 Oil Steam Reforming (OSR) components that convert the OFPC-cleaned WVO to a reformat suitable for CE5.
- Produce product interface document between the reformer and CE5
- Integrate the reformer and CE5 designs to produce the CORE-CE5 system design.
- Evaluate startup and part load operation requirements.
- Prepare a task report that documents the CORE-CE5 system design and engineering specifications for individual system components.

Products:

- Product interface document

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- System design and engineering specifications
- Draft CORE-CE5 System Design Report (including engineering specifications)
- Final CORE-CE5 System Design Report (including engineering specifications)

TASK 4 WVO CORE REFORMER FABRICATION ASSEMBLY AND TEST

The goal of this task is to develop and assemble a CORE reformer that converts the WVO into a reformat suitable for CE5 CHP system.

The Recipient shall:

- Collect previous CORE reformer test data.
- Design and fabricate the OFPC subcomponent to clean and upgrade the WVO.
- Test OFPC subcomponent.
- Develop low-emission burner.
- Test low-emission burner.
- Develop OSR that converts OFPC-cleaned fuel to a reformat suitable for CE5 as per Product Interface Document.
- Develop the control hardware and software.
- Test OSR on OFPC-upgraded fuel.
- Integrate OSR and OFPC.
- Fabricate heat-recovery module.
- Integrate the heat-recovery module.
- Integrate Balance of Plant (BOP) and control system.
- Assemble WVO CORE Reformer.
- Test WVO CORE Reformer.
- Compare emissions and performance data against goal.
- Prepare a task report that documents the WVO-CORE reformer components drawings and pictures, the reformer test, and emissions and performance data.
- Prepare CPR Report and attend 1st CPR meeting (as per Task 1.2).

Products:

- Assembly drawings
- Performance and emission data
- Draft Reformer Assembly and Test Report
- Final Reformer Assembly and Test Report

TASK 5 CORE-CE5 CHP MODULE FABRICATION

The goal of this task is for the Subcontractor to fabricate two CE5 CHP systems as the cost share to the project.

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The Recipient shall:

- Subcontractor to fabricate two CE5 CHP systems.
- Subcontractor to ship one unit to Recipient for integrated system testing.
- Prepare a task report that documents the picture of the fabricated CE5 CHP systems.
- Submit two photos of the two CE5's as part of the monthly progress report

Products:

- Draft CE5 CHP Fabrication Report
- Final CE5 CHP Fabrication Report

TASK 6 INTEGRATED CORE-CE5 SYSTEM ASSEMBLY

The goal of this task is to integrate the WVO CORE Reformer of Task 4 with the CE5 of Task 5 to produce the CORE-CE5 CHP system for initial testing.

The Recipient shall:

- Produce integrated system fabrication drawings.
- Integrate the WVO CORE Reformer of Task 4 with the CE5 delivered by Subcontractor.
- Produce the integrated system document.
- Prepare a task report that documents the integrated CORE-CE5 CHP system drawings and photos.

Products:

- Draft Task Report including Assembly Drawings
- Final Task Report including Assembly Drawings

TASK 7 INTEGRATED WVO CORE-CE5 SYSTEM TESTING

The goal of this task is to test the integrated CORE-CE5 CHP and evaluate its performance at part and full load and use this first test result to make final changes to the CORE-CE5 design. For this purpose the system will be fully instrumented to record all critical flows, temperatures, pressures, and electric power characteristics and the CHP hot water temperature and flow. In addition, gaseous emissions and reformate composition measurements will be conducted. The tests plan will cover rigorous start-up, shut-down, and load-variation tests. Following testing, results will be analyzed and any final design changes needed shall be made to produce the final CORE-CE5 design.

The Recipient shall:

- Prepare a test plan that includes:
 - Description of the test set up

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- Parameters to be measured (power, heat output, temperatures, flows, electric power, hot water temperature, emissions)
- Emissions measurements, instrumentation, and methods
- Parameters to be varied (load)
- Test duration
- Perform testing, as per test plan.
- Confirm performance as per specifications.
- Confirm emissions performance as per specifications.
- Prepare final CORE-CE5 system design.
- Prepare a task report that documents the test plan, test set up, CORE-CE5 performance data including emission data and the final system design.
- Prepare CPR Report and attend 2nd CPR meeting (as per Task 1.2).

Products:

- Draft Integrated WVO Core-CE5 System Test Plan
- Final Integrated WVO Core-CE5 System Test Plan
- Draft Integrated WVO Core-CE5 System Test Data and Final Design Report
- Final Integrated WVO Core-CE5 System Test Data and Final Design Report

TASK 8 INTEGRATED CORE CE5 SYSTEM FINAL ASSEMBLY AND SIMULATED FIELD DEMONSTRATION

The goal of this task is to use the final system design to produce the CORE-CE5 system for simulated field testing to be performed. These tests of the unit will be instrumented sufficiently to record electric power characteristics and the hot water temperature and flow and limited internal temperature and flows. In addition, gaseous emissions will be conducted. The tests shall simulate the field conditions including grid connections. Also the tests shall be long enough to assure the system longevity. Following testing, results shall be analyzed and conclusions reached on the viability of the prototype CORE-CE5 system for field demonstration.

The Recipient shall:

- Prepare a test plan that includes:
 - Description of the test set up
 - Parameters to be measured (power, heat output, temperatures, flows electric power, hot water temperature, emissions)
 - Emissions measurements, instrumentation, and methods
 - Parameters to be varied (load)
 - Test duration
- Perform field testing, as per test plan, to support the performance guarantees of 4 kWe at over 90% availability and 45,000 Btu/hour.
- Confirm performance as per specifications.

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- Confirm emissions performance as per specifications.
- Prepare a task report that documents the CORE-CE5 simulated field testing activities including test plan, test set up description and photos, system performance and emission data.

Products:

- Draft Simulated Field Testing Test Plan
- Final Simulated Field Testing Test Plan
- Draft Simulated Field Testing Report with Test Data
- Final Simulated Field Testing Report with Test Data

TASK 9 INTEGRATED CORE CE5 SYSTEM FIELD DEMONSTRATION

The goal of this task is to prepare the CORE-CE5 system for the selected host site, install, and test as per developed and reviewed test plan. The CORE-CE5 that was tested will be used for the field installation with minor modifications to meet the site special requirements if any. The system will be grid connected to demonstrate its final application. Tests will cover both short-term parametric and long-term testing to simulate fully unattended operation. During the tests, data will be collected on site and remotely to monitor the power generated, used and returned to the grid, heat generated and used, fuel consumed, and emissions (Mono-Nitrogen Oxides (NO_x), Carbon Monoxide (CO), Volatile Organic Compounds (VOC)s, and Particulate Matter (PM) generated.

The Recipient shall:

- As needed modify CORE-CE5 to meet the host site needs.
- Ship commercial field CORE-CE5 unit to the site.
- Install system at the site.
- Prepare a draft test plan including host site power and energy needs, set up and test matrix and what is measured and monitored.
- Submit a draft of the test plan and seek the Energy Commission Project Manager's approval.
- Review test plan with all participants.
- Prepare a final test plan.
- Perform preliminary startup and system checkout.
- Connect system to the grid.
- Operate the system and collect system performance and emission data according to (or in accordance with) the approved test plan.
- Prepare a task report that documents the CORE-CE5 field testing activities including, test plan, test set up description and photos, system performance and emission data and recommendations on long term plan for the installed unit at the site.

Products:

- Draft Site Installation and Field Testing/Demonstration Test plan

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- Final Site Installation and Field Testing/Demonstration Test plan
- Draft Installation and Field Testing Report w/ Test Data
- Final Installation and Field Testing Report w/ Test Data

TASK 10 SYSTEM EVALUATION

The goal of this task is to use the site-demonstration data along with the Task 7 and 8 data to define the CORE-CE5 performance. The system performance will be compared with the system goals and specifications defined at the beginning of the program. The longevity test results will be used to project the long-term durability of the CORE-CE5 and its components. Prototype system as-built weight and volume will be compared to the goals, set at the beginning of the effort. In addition, the system capital and operating costs and the site inputs will be used to define a detailed economic analysis and system short and long term marketability.

The Recipient shall:

- Collect and document field data for at least 6 months.
- Collect and document Task 7 and 8 data.
- Define system power and heat generation performance based on test data.
- Define system emission performance.
- Define the system grid connectivity performance.
- Compare system performance against goals.
- Define system capital cost.
- Define system operating cost.
- Perform detailed economic analysis, define payback and recommend commercialization path.
- Prepare a task report that documents an analysis of the field demonstration data to show how the CORE-CE5 performance and emissions meet the system goals and emission regulations. The report also documents the system cost and an economic analysis defining the payback period.

Products:

- Draft Performance, Emissions, Cost Evaluation Report
- Final Performance, Emissions, Cost Evaluation Report

TASK 11 TECHNOLOGY TRANSFER ACTIVITIES

The goal of this task is to develop a plan to make the knowledge gained, experimental results and lessons learned available to key decision-makers.

The Recipient shall:

Exhibit A WORK STATEMENT

- Prepare a Technology Transfer Plan that explains how the knowledge gained in this project will be made available to the public and to the targeted market with the key elements included in the Final Report for this project.
- Conduct technology transfer activities as per Technology Transfer Plan.

Products:

- List of technologies transfer activities
- Draft versions of papers for publication
- Final versions of published papers
- Copies of meeting conference agendas, presentations, and reports
- Trip reports on conference(s)/meeting(s) emphasizing value of attendance to the project

TASK 12 PRODUCTION READINESS PLAN

The goal of the plan is to document the steps that will lead to the manufacturing and commercialization of the CORE-CE5.

The Recipient shall:

- Prepare a Production Readiness Plan, which shall include:
 - Identification of critical production processes, equipment, facilities, personnel resources, and support systems that will be needed to produce a commercially viable product;
 - Internal manufacturing facilities, as well as supplier technologies, capacity constraints imposed by the design under consideration, identification of design critical elements and the use of hazardous or non-recyclable materials. The product manufacturing effort may include proof of production processes;
 - Define how the current CE5 manufacturing process affects the CORE-CE5 manufacturing
 - The cost of the CORE-CE5 product
 - The incremental cost of CORE-CE5 over CE5
 - The projected cost for the next five years
 - Market size and entry price including the price for early and late adaptors
 - The source of investment to commercial the CORE-CE5
 - An implementation plan to ramp up to full production
 - Develop a marketing plan.

Deliverables:

- Draft Production Readiness Plan
- Final Production Readiness Plan
- Draft Marketing Plan
- Final Marketing Plan