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TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	ADMINISTRATION
2		OPERATE ANAEROBIC DIGESTION POWER GENERATION (ADPG) SYSTEM
3	X	ADPG SYSTEM SAMPLES COLLECTION
4		TECHNICAL ADPG SYSTEM SAMPLES ANALYSIS
5		TECHNOLOGY TRANSFER ACTIVITIES: COST BENEFIT ANALYSIS
6		PRODUCTION READINESS PLAN

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1-6	NONE	NONE	NONE

GLOSSARY

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

Term/ Acronym	Definition
ADPG	Anaerobic Digestion Power Generation
B	Boron
BEI	Biogas Energy, Inc.
CDC	California Dairy Campaign
CH_4	Methane
Cl	Chlorine
CO_2	Carbon Dioxide
CPR	Critical Project Review
CVRWB5	Central Valley Regional Water Board, Region 5
EC	Electro-conductivity
FF	Fiscalini Farms, L.P.
GHG	Green House Gas
H_2O	Water
H_2S	Hydrogen Sulfide
IC	Internal Combustion
K	Potassium
kW	Kilowatt
Mg	Magnesium
MID	Modesto Irrigation District

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Term/ Acronym	Definition
N	Nitrogen
Na	Sodium
P	Phosphorous
PAC	Project Advisory Committee
PIER	Public Interest Energy Research
RD&D	Research, Development and Demonstration
SCR	Selective Catalytic Reduction
SJVAPCD	San Joaquin Valley Air Pollution Control District
Sus. Con.	Sustainable Conservation
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UOP	University of the Pacific
VOC	Volatile Organic Compounds
WUD	Western United Dairymen

Problem Statement:
The project will address the technical, economic and regulatory feasibility of using various feedstocks to produce biogas in a dairy anaerobic digestion power generation system at Fiscalini Farms, L.P. dairy in the San Joaquin Valley of California. Outside of the United States, there has been progress in the development of state-of-the-art technology for anaerobic digestion and power generation. This technology is environmentally friendly since it uses agricultural and/or food processing wastes and transforms them into biogas which can be used to produce electricity and heat. This results in lowered energy costs for the host site and in reduction of greenhouse gas emissions.

However, the barriers that impact the acceptance and commercialization of anaerobic digestion technology include:

- Scientific and Technology: There is minimal technical and actual field test data available on air emissions and water quality impacts, and detailed engineering design trade off analysis.
- Market: There is insufficient data on the costs and benefits of this technology, including initial capital cost, other recurring costs and all savings and benefits. Additionally, customers lack understanding of proper operation of systems to maximize benefits. There is also an inadequate number of field experienced technology providers operating in California.
- Institutional: Regulatory policy that could be changed if supported with technical data.
- Environmental: Inadequate technology to meet air emission regulatory standards (H2S, NOX, SOX), inadequate understanding of the water quality impact to groundwater.

This project will develop solid data and information to address these barriers and enhance the commercialization of this technology.

Goal of the Project:
The goal of this project is to use multiple feedstocks in a European anaerobic digestion and power generation system and to verify that it can operate effectively, efficiently, and economically and meet California's environmental regulations.

Objectives of the Project: The objectives of this agreement are to:

1) Measure quality and quantity of captured gas produced using various feedstocks, including: cow manure, silage, whey and cheese waste from industrial food processing, in terms of Btu produced/pound (or ton) of feed stock.

2) Complete a cost benefit analysis of the entire ADPG system, showing all operating, maintenance and other costs and the benefits, such as energy and process heat production and byproduct sales.

3) Measure and quantify all environmental impacts and benefits created by this system design

4) Verify the ADPG system will meet or exceed all environmental regulatory requirements for California and explain any barriers or possible solutions to meeting these requirements

5) Discuss the impact of the system on groundwater.

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 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 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.

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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)

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

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 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 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

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 expenditures 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:
  - 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: OPERATE ANAEROBIC DIGESTION POWER GENERATION (ADPG) SYSTEM

The goal of this task is to operate the ADPG system continuously and collect data on operation of the anaerobic digester and the power generator using various feedstocks.

The Recipient shall:

- Generate an operation and maintenance plan for the ADPG system.
- Generate operation and service record form for the anaerobic digestion (AD) portion of the system and include a recording of the type of fuel used (e.g., cow manure, silage, whey and cheese waste from industrial food processing).
- Generate operation and service record form for the power generation (PG) portion of the system and include a recording of the type of fuel (dairy manure, cheese whey, industrial by-products, etc) used.

Products:

- Draft Operation and Maintenance Plan report
- Final Operation and Maintenance Plan report
- Draft AD service record form.
- Final AD service record form
- Draft PG service record form.
- Final PG service record form

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TASK 3: ADPG SYSTEM SAMPLES COLLECTION

The goal of this task is to collect data from the anaerobic digester system, the biogas transport system, and the power generation system that are operating using various biomass feedstock, such as, cow manure, silage, whey and cheese waste from industrial food processing. The samples will be collected by a third party using scientific protocols and chain of custody documentation to ensure the samples are unbiased and scientifically sound.

The Recipient shall:

For each feedstock, as appropriate:

- Develop a draft and final list of all scientific protocols to be used for sample collections.
- Collect influent and effluent samples from the anaerobic digester tanks and the three phase separator.
- Collect sample of solids removed by the screw press separator.
- Collect effluent sample of the storage lagoon prior to mixing with delivered irrigation water.
- Collect irrigation water sample after mixing as irrigation water is delivered to the field.
- Collect biogas samples at the anaerobic digester tanks, the flare, and prior to the engine, and identify the feedstock(s) used.
- Collect biogas samples prior to the selective catalytic reduction (SCR) stage of the unit, after the SCR, after the heat exchanger and at the exhaust outlet.
- Collect groundwater samples annually, utilizing the already existing monitoring well network.
- Prepare a laboratory report that includes the following, at a minimum:
  - Date of collection, time of collection, ambient temperature when collection taken, person taking the collection, location of collection, and volume of collection, and identification of the feedstock(s) used,
  - Laboratory results from the following:
    - Water samples from the anaerobic digester tanks and the three phase separator;
    - Solid samples from the screw press separator;
    - Water samples from the storage lagoon;
    - Water sample from the head of each irrigation delivery to each field;
    - Water sample groundwater monitoring well system currently in place;
    - Biogas sample from anaerobic digestion tanks outlet, the flare outlet, and the outlet prior to the internal combustion engine.
    - Biogas samples prior to and after the SCR
    - Biogas after the heat exchanger and the exhaust outlet.
- Participate and prepare CPR report per Task 1.2.

Products:

- Draft list of all scientific protocols to be used for water and air samples.
- Final list of all scientific protocols to be used for water and air samples.

- Laboratory Report (no draft)

TASK 4: TECHNICAL ADPG SYSTEM SAMPLES ANALYSIS

The goal of this task is to provide a laboratory analysis of each water and biogas sample collected to determine the constituents of each sample. The water samples will be tested for nitrogen (N), phosphorous (P), potassium (K), electro-conductivity (EC), alkalinity or acidity (pH), total dissolved solids (TDS), total suspended solids (TSS), chlorine (Cl), and boron (B). The biogas samples will be tested for hydrogen sulfide (H_2S), carbon dioxide (CO_2), methane (CH_4), water (H_2O) and volatile organic compounds (VOC).

The Recipient shall:

For each feedstock (e.g., cow manure, silage, whey and cheese waste from industrial food processing, or combinations, thereof):

- Perform monthly analysis, starting with the commencement of this task, of influent and effluent from the digester that includes total N, P, K, EC, pH, TDS, TSS, and Cl.
- Perform monthly analysis of influent and effluent from the three phase separator that includes, total N, P, K, EC, pH, TDS, TSS, and Cl.
- Perform monthly analysis of influent and effluent from the storage lagoon water that includes, total N, P, K, EC, pH, TDS, TSS, and Cl.
- Perform monthly analysis of influent and effluent mixed irrigation water that includes, total N, P, K, EC, pH, TDS, TSS, and Cl.
- Analyze the Annual Groundwater samples for Nitrate-N, Ammonium-N, P, K, EC, pH, TDS, fecal Coliform, bicarbonate, carbonate, Cl, magnesium (Mg), sodium (Na), and B.
- Monthly analysis of separated solids for total N, P and K.
- Weekly analysis of biogas samples from the anaerobic digester (AD) tanks for H2S, CO2, and CH4. Determine Btu of the biogas per pound (or ton) of feedstock.
- Monthly analysis of biogas samples from tanks, flare outlet, prior to the internal combustion (IC) engine, SCR, exhaust for H2S, CO2, CH4, H2O, and VOC.
- Quarterly analysis of biogas for ammonia (NH3)
- Annual assessment (estimate) of green house gas emissions produced and saved.
- Prepare Laboratory Report which includes, but is not limited to, the results of the laboratory analysis as described above, and discusses the quality, quantity of the captured gas produced for each feedstock.

Products:

- Laboratory Report (no draft)

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TASK 5: TECHNOLOGY TRANSFER ACTIVITIES: COST BENEFIT ANALYSIS
The goal of this task is to complete a comprehensive analysis of the costs and benefits associated with operating and maintaining an ADPG system. The analysis is to determine the economic viability and technical capability of the ADPG system when all income and expenses are evaluated.

The Recipient shall:

- Prepare a cost benefit analysis of the ADPG System for each feedstock tested. The cost benefit analysis shall include, but not be limited to the following:
  - Identify all expenses for the ADPG system, including, but not limited to, design, development, installation, operation, maintenance, and regulatory permitting.
  - Identify all income generated from operation of the ADPG System, including, but not limited to, energy production and dollar value of the energy, by-products sales, and reduction in waste disposal cost, quality, quantity and value of the captured gas produced using various feedstocks. Measure, quantify and report on all environmental benefits and impacts created by operation of the ADPG System, including both air and groundwater impacts.
  - Specify whether system can operate effectively, and economically to meet or exceed the state's environmental regulatory requirements and identify barriers or possible solutions to meeting these requirements.
- Prepare a Technology Transfer Plan. The plan will explain how the knowledge gained in this project will be made available to the public. This will include the preparation of papers for peer-reviewed journals and for presentation at conferences.
- Promote the technology/results to the dairy, agricultural and food processing industry in California once technically and economically proven in commercial operation

Products:

- Draft Cost Benefit Analysis
- Final Cost Benefit Analysis
- Draft report for Technology Transfer Activities.
- Final report for Technology Transfer Activities.

TASK 6: PRODUCTION READINESS PLAN
The goal of the plan is to determine the steps that will lead to the commercialization of the project's results.

The Recipient shall:

- Prepare a Production Readiness Plan. The degree of detail in the Production Readiness Plan discussion should be proportional to the complexity of commercializing the proposed product and its state of development. The plan shall include, , but not be limited to:

  - 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.”
- A projected “should cost” for the product when in production.
- The expected investment threshold to launch the commercial product.
- An implementation plan to ramp up to full production.

Products:

- Draft Production Readiness Plan
- Final Production Readiness Plan