



Erik Jacobson
Director
Regulatory Relations

Pacific Gas and Electric Company
77 Beale St., Mail Code B13U
P.O. Box 770000
San Francisco, CA 94177

Fax: 415-973-3582

June 14, 2019

Advice 4106-G

(Pacific Gas and Electric Company ID U 39 G)

Public Utilities Commission of the State of California

Subject: Summary of PG&E's Progress Assessing the Feasibility of Options for Providing Affordable Clean Energy to Monterey Park Tract

Purpose

Pursuant to Ordering Paragraph (OP) 2 of California Public Utilities Commission (CPUC or Commission) Decision (D.) 18-12-015, issued on December 19, 2018, Pacific Gas and Electric Company (PG&E) submits this Tier 1 Advice Letter (AL) for its Summary of PG&E's Progress Assessing the Feasibility of Options for Providing Affordable Clean Energy to Monterey Park Tract (Monterey Park Tract Feasibility Study), as shown in Attachment A.

Background

In 2015, the Commission initiated a rulemaking to identify disadvantaged communities in the San Joaquin Valley, and then to evaluate the feasibility of options to improve access to affordable energy in these communities.¹ To assist the Commission in addressing these goals, D.18-12-015 approved pilots in eleven San Joaquin Valley Disadvantaged Communities (SJV DAC) and deferred approval of a 12th pilot in Monterey Park Tract (MPT).

The feasibility study is for further exploring and developing the renewable natural gas microgrid or tank pilot project for MPT, with an emphasis on securing a dairy digester partner and more thoroughly assessing the costs and timeline of a proposed MPT project, and consulting with Turlock Irrigation District and the California Energy Commission regarding the potential for electrification of MPT.

¹ *Order Instituting Rulemaking to Identify Disadvantaged Communities in the San Joaquin Valley and Provide Economically Feasible Options for Affordable Energy*, R. 15-10-030, p. 2 (April 3, 2015).

Regarding a PG&E proposal for a gas microgrid pilot in MPT,² the Commission ordered:

We direct Pacific Gas and Electric Company (PG&E) to further explore and develop the renewable natural gas microgrid or tank pilot project for Monterey Park Tract (MPT), with an emphasis on securing a dairy digester partner and more thoroughly assessing the costs and timeline of the proposed project; consult with Turlock Irrigation District and the California Energy Commission regarding the potential for electrification of MPT; and file a summary of its progress assessing the feasibility of options for providing affordable clean energy to MPT....³

Request

PG&E requests the Commission to adopt its final recommendation to approve the MPT pilot as described in its Monterey Park Tract Feasibility Study provided in Attachment A to this advice letter.

Protests

Anyone wishing to protest this submittal may do so by letter sent via U.S. mail, facsimile or E-mail, no later than July 5, 2019, which is 21 days⁴ after the date of this submittal. Protests must be submitted to:

CPUC Energy Division
ED Tariff Unit
505 Van Ness Avenue, 4th Floor
San Francisco, California 94102

Facsimile: (415) 703-2200
E-mail: EDTariffUnit@cpuc.ca.gov

Copies of protests also should be mailed to the attention of the Director, Energy Division, Room 4004, at the address shown above.

The protest shall also be sent to PG&E either via E-mail or U.S. mail (and by facsimile, if possible) at the address shown below on the same date it is mailed or delivered to the Commission:

² D. D.18-12-015, pp.47-50.

³ *Id.* p. 161 (OP 2).

⁴ The 20-day protest period concludes on a holiday, therefore, PG&E is moving this date to the following business day.

Erik Jacobson
Director, Regulatory Relations
c/o Megan Lawson
Pacific Gas and Electric Company
77 Beale Street, Mail Code B13U
P.O. Box 770000
San Francisco, California 94177

Facsimile: (415) 973-3582
E-mail: PGETariffs@pge.com

Any person (including individuals, groups, or organizations) may protest or respond to an advice letter (General Order 96-B, Section 7.4). The protest shall contain the following information: specification of the advice letter protested; grounds for the protest; supporting factual information or legal argument; name, telephone number, postal address, and (where appropriate) e-mail address of the protestant; and statement that the protest was sent to the utility no later than the day on which the protest was submitted to the reviewing Industry Division (General Order 96-B, Section 3.11).

Effective Date

Pursuant to OP 2 of D.18-12-015, this Advice Letter is subject to Energy Division disposition and should be classified as Tier 1, Effective Pending Disposition, pursuant to General Order (GO) 96-B. PG&E respectfully requests this Advice Letter be effective June 14, 2019, which is the date submitted.

Notice

In accordance with General Order 96-B, Section IV, a copy of this advice letter is being sent electronically and via U.S. mail to parties shown on the attached list and the parties on the service list for R.15-03-010. Address changes to the General Order 96-B service list should be directed to PG&E at email address PGETariffs@pge.com. For changes to any other service list, please contact the Commission's Process Office at (415) 703-2021 or at Process_Office@cpuc.ca.gov. Send all electronic approvals to PGETariffs@pge.com. Advice letter submittals can also be accessed electronically at: <http://www.pge.com/tariffs/>.

/S/

Erik Jacobson
Director, Regulatory Relations

Attachments

cc: Service List R.15-03-010



ADVICE LETTER SUMMARY

ENERGY UTILITY



MUST BE COMPLETED BY UTILITY (Attach additional pages as needed)

Company name/CPUC Utility No.: Pacific Gas and Electric Company (ID U39 G)

Utility type:

- ELC GAS WATER
 PLC HEAT

Contact Person: Annie Ho

Phone #: (415) 973-8794

E-mail: PGETariffs@pge.com

E-mail Disposition Notice to: AMHP@pge.com

EXPLANATION OF UTILITY TYPE

ELC = Electric GAS = Gas WATER = Water
 PLC = Pipeline HEAT = Heat

(Date Submitted / Received Stamp by CPUC)

Advice Letter (AL) #: 4106-G

Tier Designation: 1

Subject of AL: Summary of PG&E's Progress Assessing the Feasibility of Options for Providing Affordable Clean Energy to Monterey Park Tract

Keywords (choose from CPUC listing): Compliance,

AL Type: Monthly Quarterly Annual One-Time Other:

If AL submitted in compliance with a Commission order, indicate relevant Decision/Resolution #: D.18-12-015

Does AL replace a withdrawn or rejected AL? If so, identify the prior AL: No

Summarize differences between the AL and the prior withdrawn or rejected AL:

Confidential treatment requested? Yes No

If yes, specification of confidential information:

Confidential information will be made available to appropriate parties who execute a nondisclosure agreement. Name and contact information to request nondisclosure agreement/ access to confidential information:

Resolution required? Yes No

Requested effective date: 6/14/19

No. of tariff sheets: N/A

Estimated system annual revenue effect (%): N/A

Estimated system average rate effect (%): N/A

When rates are affected by AL, include attachment in AL showing average rate effects on customer classes (residential, small commercial, large C/I, agricultural, lighting).

Tariff schedules affected:

Service affected and changes proposed¹: N/A

Pending advice letters that revise the same tariff sheets: N/A

¹Discuss in AL if more space is needed.

Protests and all other correspondence regarding this AL are due no later than 20 days after the date of this submittal, unless otherwise authorized by the Commission, and shall be sent to:

CPUC, Energy Division
Attention: Tariff Unit
505 Van Ness Avenue
San Francisco, CA 94102
Email: EDTariffUnit@cpuc.ca.gov

Name: Erik Jacobson, c/o Megan Lawson
Title: Director, Regulatory Relations
Utility Name: Pacific Gas and Electric Company
Address: 77 Beale Street, Mail Code B13U
City: San Francisco, CA 94177
State: California Zip: 94177
Telephone (xxx) xxx-xxxx: (415)973-2093
Facsimile (xxx) xxx-xxxx: (415)973-3582
Email: PGETariffs@pge.com

Name:
Title:
Utility Name:
Address:
City:
State: District of Columbia Zip:
Telephone (xxx) xxx-xxxx:
Facsimile (xxx) xxx-xxxx:
Email:

Advice 4106-G
June 14, 2019

Attachment A

Monterey Park Tract Feasibility Study

**PACIFIC GAS AND ELECTRIC COMPANY
SAN JOAQUIN VALLEY DISADVANTAGED
COMMUNITIES OIR REPORT**

R.15-03-010

**PG&E San Joaquin Valley Disadvantaged
Communities Monterey Park Tract Feasibility Study**

JUNE 17, 2019



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Attachment A – Black & Veatch Report

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PG&E SJV DAC Monterey Park Tract Feasibility Study

Introduction and Summary of Recommendation to Approve Microgrid Proposal

This Feasibility Study describes the additional steps Pacific Gas and Electric Company (PG&E) performed to further explore the opportunities to serve the Monterey Park Tract (MPT) community, a San Joaquin Valley (SJV) Disadvantaged Community (DAC), as ordered by the California Public Utilities Commission's (Commission) Decision (D.) 18-12-015 (the Decision).

In 2018 PG&E submitted a proposal to develop a local gas distribution network to serve the MPT community that would ultimately be fed using Renewable Natural Gas (RNG) from a local source. Consistent with D.18-12-015, PG&E has further explored the opportunities at MPT with a focus on the local RNG source, which would not be covered by the proposed SJV DAC pilot budget for MPT. PG&E hired Black & Veatch (B&V)¹ and Gladstein, Neandross and Associates (GNA)² to provide expert consultation for this work.

PG&E finds the dairy digester to be a viable economic option for serving MPT: when comparing the cost analysis provided by B&V with the Incentives Report from GNA, PG&E finds that the simple payback period could be less than three years, which is highly favorable. Leveraging incentive programs for the dairy digester and the refueling station, including credits from for Low Carbon Fuel Standard (LCFS) credits and Federal Renewable Fuel Standard (RFS), for costs not covered within the SJV DAC proceeding make this project worth pursuing. Not only does the proposal have a strong economic outcome, it also helps reduce greenhouse gas (GHG) emissions and improve the air quality in the surrounding community.

¹ B&V is an employee-owned engineering, procurement, consulting and construction company, which has been in business for 103 years. B&V has more than 10,000 professionals and over 100 offices worldwide, including multiple offices in California and a headquarters office in Kansas City.

As a leader in the planning and design of wastewater treatment facilities, B&V has acquired strong experience in all aspects of biogas production and utilization, including cogeneration facilities, biogas cleaning technologies, and the production of RNG. Over the last 12 years, B&V has been evaluating California dairy manure digestion opportunities, issues, technologies, and costs. B&V has been involved in the development of biogas utilization projects for decades.

² GNA is one of the nation's leading experts on alternative fuel and electric transportation technologies. With offices in Arizona, California, New York and Texas, GNA assists private fleets, public agencies and not-for-profit environmental organizations identify, develop and implement policies, incentives and programs to accelerate the commercialization and deployment of low, near zero and zero emission motor vehicles, off-road equipment, locomotives and ocean-going vessels. Over the last 25 years GNA has written over 400 successful grant applications for more than \$610 million in awards for its clients.

As stated in D.18-12-015, the Commission’s intent in approving the further exploration is to more thoroughly assess the costs and timeline of a proposed MPT project, and consult with Turlock Irrigation District (TID) and the California Energy Commission (CEC) regarding the potential for electrification of MPT with an emphasis on securing a dairy digester partner.³ A detailed history of the legislative and procedural activity leading to the pilots is provided in the decision and not repeated here; however, PG&E does provide the Commission’s stated goals and objectives for these pilots:⁴

- “The dual goal[s] of the pilots are to provide cleaner, more affordable energy options to propane and wood burning and gather real time data needed to assess the economic feasibility of extending affordable energy options to all listed SJV DACs”; and
- “The pilot objectives are as follows:
 - Gather inputs to assess cost-effectiveness and feasibility during Phase III;
 - Provide access to affordable energy options in participating pilot host communities;
 - Reduce household energy costs for participating pilot host customers;
 - Increase health, safety and air quality of participating host pilot communities;
 - Test approaches to efficiently implement interventions;
 - Assess potential scalability.”⁵

PG&E believes the proposal for MPT meets all the pilot objectives as stated above. This study represents PG&E’s best information as of the date of the advice letter filing; however, it is subject to change. Changes may include cost and schedule modifications depending on final vendors and developers selected to perform work if approved to proceed with the gas microgrid.

³ D.18-12-015, pp. 49-50, 161 (Conclusion of Law 28, Ordering Paragraph 2).

⁴ D.18-012-015, p. 10 (Note that page references are consistent with the version of D.18-12-015 served on December 20, 2019 appended to President Picker’s Dissent. A later version has slightly different pagination). Referred to throughout as the decision or SJV DAC Pilots Decision.

⁵ D.18-012-015, pp. 10-11 (Note that page references are consistent with the version of D.18-12-015 served on December 20, 2019 appended to President Picker’s Dissent. A later version has slightly different pagination). Referred to throughout as the decision or SJV DAC Pilots Decision.

Gas Microgrid pilot Digester Design, Cost and Timeline

PG&E took the following steps to gather additional data and explore the gas microgrid pilot project:

- PG&E engaged with a local dairy adjacent to the MPT community to partner with PG&E in serving the community;
- PG&E contracted B&V to prepare a conceptual design package, permitting matrix, cost and schedule for installing a dairy digester, biogas⁶ clean up system and a public compressed natural gas (CNG) fueling station at the partner dairy;
- PG&E engaged Western United Dairymen to review the proposal and provide feedback;
- PG&E and B&V engaged multiple dairy digester developers to provide bid packages to inform the cost estimates;
- PG&E contracted GNA to provide an Incentives Report with a summary of programs that can be harnessed to provide both public and private resources for the development of dairy digester projects and associated conditioning and interconnect infrastructure to deliver dairy manure-derived RNG to the MPT Project; and
- PG&E consulted the CEC regarding potential opportunities for Research and Development (R&D) and funding for the dairy digester and microgrid proposal.

Dairy Partner

PG&E engaged with Trinkler Dairy Farms Inc. (Trinkler) whose property is adjacent to the east side of MPT, in an effort to secure a local partner dairy for the project. Trinkler is a small family-owned dairy established in 1960 and incorporated in California. Trinkler has approximately 1,500 milking cows. Trinkler is very open to helping the community and considering the concept of installing the anaerobic digester (AD), biogas clean-up system, and CNG fueling station on their property. Trinkler met with PG&E and B&V to discuss their operations and the conceptual layout of the required equipment. Additionally, Trinkler allowed PG&E to return to the dairy property to meet with one of the AD developers, walk the property and discuss the proposal with the developer.

Trinkler was unable to commit to next steps until they see the details from this filing to determine if it would financially make sense for them to move forward with the proposal. As long as it is economically beneficial for the dairy to proceed forward, Trinkler has indicated it would consider the project and continue to engage with PG&E if approved by the Commission.

Dairy Digester Conceptual Design and Production

B&V's design is based on a covered lagoon digester. Trinkler currently utilizes a flush-type manure collection system. Covered lagoon digesters typically include minimal pretreatment and conditioning of digester influent (i.e., oversized particle or bedding separation) and are unheated. Digestate from the process is typically pumped into a storage lagoon and used as an agricultural fertilizer.

⁶ "Biogas" refers to the untreated gas produced from the digester. Biogas needs to be cleaned and treated before it can be transported and used in most commercial operations or injection into the pipeline system. RNG refers to biogas which has been cleaned to meet the pipeline gas quality tariff requirements.

Based on the analysis completed by B&V, using a covered lagoon AD system and membrane-based biogas cleaning system an RNG production rate of 37,200 to 39,500 thousand cubic feet (MCF) per year was estimated. The MPT community would use very small portion of this total production, estimated at 1,815 MCF/year or approximately 5 percent.⁷ Figure 1 below shows the estimated RNG production at Trinkler based on the Mass and Energy balances:

**FIGURE 1
Dairy Mass and Energy Balance Summary**

PARAMETER	UNITS	SUMMER	WINTER
Combined Flow from Barns	lb/hr	110,091	134,700
Influent to Digester	lb/hr	107,130	131,078
Raw Biogas Production	scfm	122.3	115.1
RNG to MPT	scfm	2.5	2.5
RNG to Local Refueling	scfm	13.3	13.3
RNG to Tube Trailers	scfm	63.4	58.7
Total RNG	MCF/yr	39,500	37,200

Dairy Digester Major Tasks and Timeline

The primary tasks completed by B&V on behalf of PG&E to further assess the opportunity to install a dairy digester to serve the MPT community with RNG included:

- Gather data specific to dairy operations
- Design package:
 - Process flow diagrams / heat material balances
 - Equipment list
 - Electrical one-line and load list
 - General arrangement drawing
- Prepare Environmental Permitting matrix
- Prepare a Schedule and Cost estimate
 - EPC schedule
 - Capital cost
 - Operations and maintenance cost

⁷ Estimated usage is based on usage in similar sized homes with natural gas service five miles away in Ceres, CA.

From the work completed by B&V, PG&E is able to provide the estimated timeline and tasks required to install all equipment to produce the RNG and build the CNG fueling station that will serve the MPT community as ordered by D.18-12-015. The timeline in Figure 2 provides a high-level key milestone schedule from the notice to proceed (NTP) date for installing and commissioning the dairy digester and microgrid. Based on the conceptual engineering design package and expected permitting requirements, B&V developed a proposed schedule with a 22-month duration to implement the project including permitting, engineering, procurement, construction, and commissioning.

**FIGURE 2
PG&E Dairy Digester Development TIMELINE**

Key Milestone Dates

PROJECT MILESTONE	DATE AFTER NTP
Permitting	12 months
Detailed Engineering	13.5 months
Procurement	18 months
Construction	21 months
Commissioning and Testing Completion	22 months
Commercial Operation Date	22 months

A more detailed timeline will be developed in consultation with Trinkler and selected developer if the project is approved to proceed forward.

Dairy Digester Estimated Costs

B&V’s conceptual cost estimate is classified as an American Association of Cost Engineers⁸ Class 4 estimate with an accuracy of ±30 percent. Furnish and erect packages and equipment material prices were estimated primarily using vendor budgetary quotations for the digester, biogas cleaning, and refueling systems. The balance of equipment was estimated using in-house pricing based on historical project data. All costs are expressed in 2019 United States Dollars (USD). This excludes the costs of the gas distribution facilities needed to serve the MPT community that were estimated in the initial proposal filed earlier in the proceeding. Other exclusions from this cost estimate include permitting fees, capital spares, taxes/duties, liability insurance, letters of credit/bonds, tariff impacts, hazardous materials handling/abatement, and other Trinkler costs.

⁸ <https://web.aacei.org/>.

A capital cost range of \$7,209,000 to \$9,761,000 was estimated for the project, as shown in Figure 3. All labor costs have been adjusted to reflect California rates and productivity. The high end of the cost range reflects an engineering, procurement support, and construction management (EpCM) execution approach. The low end of the cost range represents a developer-led approach instead of EpCM approach, resulting in savings of approximately 25-30 percent as detailed below. Together these cost estimates indicate an approximate upper and lower range for the anticipated capital cost of the project. The cost reductions for the developer-led cost estimate include the following adjustments:

- Reduction in engineering costs within the digester design (with engineering costs taken out of the “Lagoon Digester” line item and moved to the integrated “Engineering” line item);
- Reduced labor hours and increased labor efficiency, leveraging the experience and lower blended labor costs with an experienced digester developer team engaged;
- Contingency eliminated from the budget to reflect the lower potential cost range for the project; and
- Reduced or eliminated material cost contingencies in several categories associated with no longer having a third-party EpCM integrator.

FIGURE 3
PG&E Dairy Digester Development Capital Costs⁹

DESCRIPTION	EpCM CAPITAL COST	DEVELOPER-LED CAPITAL COST
Direct Costs		
Site Work	\$835,000	\$835,000
Foundations and Concrete	\$175,000	\$162,000
Steel	\$320,000	\$250,000
Fire Protection System	\$300,000	\$150,000
Lagoon Digester	\$2,279,000	\$1,710,000
Biogas Cleaning System	\$1,925,000	\$1,500,000
Refueling System	\$862,000	\$854,000
Piping	\$460,000	\$130,000
Electrical Equipment and Bulks	\$547,000	\$390,000
Insulation and Painting	\$62,000	\$59,000
Productivity Adjustment	\$124,000	\$0
Total Direct Cost	\$7,889,000	\$6,107,000
Indirect Costs		
Construction Management and Startup Staff	\$420,000	\$210,000
Subcontractor Indirects	\$479,000	\$192,000
Engineering	\$508,000	\$700,000
Contingency	\$465,000	\$0
Total Indirect Field Costs	\$1,872,000	\$1,102,000
TOTAL CAPITAL COST	\$9,761,000	\$7,209,000

B&V also estimated Operation and Maintenance (O&M) costs for the project to be approximately \$515,000 per year as shown in Figure 4. All O&M cost estimates are presented in 2019 USD. The list of assumptions made to develop the O&M estimate is provided the detailed B&V report in Attachment A.

⁹ Capital Costs are in addition to the \$4.1 million In Front of Meter and Behind The Meter costs identified in PG&E's microgrid proposal for the MPT community filed on October 8, 2018. The capital costs provided by B&V would be the responsibility of Trinkler.

FIGURE 4
PG&E Dairy Digester Development Operation and Maintenance (O&M) Costs¹⁰

DESCRIPTION	TOTAL COST
H ₂ S Removal Media Replacement	\$43,000
Biogas Conditioning / Upgrading System Maintenance	\$51,000
Refueling System Maintenance	\$20,000
Electric Power	\$205,000
Water Requirement	\$0
Propane for Thermal Oxidizer	\$19,000
Labor	\$130,000
Contingency (10% of Subtotal)	\$47,000
TOTAL O&M	\$515,000

Funding, Grant and Climate Credit Opportunities for the dairy digester

GNA’s Incentives Report identifies several potential financial resources that can be utilized to help support the costs associated with the development of a dairy digesters to serve MPT.

Financial Opportunities through Digester Infrastructure Programs

The following incentive programs provide funding for capital costs and/or operational expenses related to the construction and installation of digester facilities as well as associated clean up and interconnection infrastructure. Additional details regarding each program is available in the GNA report provided in the Attachment B.

- **Community-Scale Advanced Biofuels Production Facilities.** Community-scale projects (100,000 to 1,000,000 Diesel Gallon Equivalent (DGE))¹¹ are eligible for up to \$3,000,000.
- **Dairy Digester Research and Development Program.** Awards up to 50 percent of the total project cost with a maximum grant award of \$3,000,000 per project.
- **Demonstration-Scale Advanced Biofuels Production Facilities.** Awards up to 75 percent per project or \$3,000,000, whichever is less
- **FY19 Bioenergy Technologies Office Multi-Topic Funding Opportunity Announcement (AOI 9: Rethinking Anaerobic Digestion).** Awards up to \$3 million per project.
- **Rural Energy for America Program (REAP).** Grants 25 percent of project cost up to \$500,000 and \$25 million loan guarantee.

¹⁰ O&M Costs are in addition to the \$4.1 million In Front of Meter and Behind The Meter costs identified in PG&E’s microgrid proposal for the MPT community filed on October 8, 2018. These O&M costs would be the responsibility of Trinklér.

¹¹ 1 MCF of Natural Gas=0.1393 DGE. Projects with 13,930-139,300 MCF RNG would qualify for this program. Conversion rate available at: https://afdc.energy.gov/fuels/equivalency_methodology.html.

- **Modified Accelerated Cost-Recovery System (MACRS).** *Businesses may recover investments through depreciation deductions from taxes over 3-5-year depreciation period.*

Alternative Fuel Vehicle and Refueling Infrastructure Programs

A critical success factor of dairy digester projects is the ability to sell surplus RNG to the transportation sector, where it has the highest monetary value. The proposal from PG&E regarding the production of RNG to serve MPT recognizes this factor and provides the community, local businesses and residents with a public CNG fueling station on the Trinkler property along a public road. With the availability of a CNG fueling station utilizing the excess RNG, Trinkler and others in the surrounding area could convert their fleets to CNG vehicles with the support of a number of incentive programs. Trinkler could leverage some of the incentive programs to convert a portion of the Trinkler fleet to Near Zero Emission CNG vehicles to reduce costs on purchasing diesel fuel and further reducing its carbon footprint. Other local businesses and residents could also take advantage of the incentives and availability of the CNG fueling station since the station will be open to the public to purchase CNG as an alternative vehicle fuel. Additionally, the refueling infrastructure could be eligible for incentive that help expand the availability of alternative clean fuels within California and specifically in the SJV.

The following incentive programs provide funding for the purchase and deployment of low and near zero emission vehicles that could be end users of dairy RNG.

- **Advanced Freight and Fleet Technologies Program.** *Program is under development and expected to open in the third quarter of 2019. The anticipated incentive would likely include charging infrastructure development.*
- **California VW Program for Combustion Freight and Marine.** *Applicants may be eligible for \$35,000-85,000 per ultra-low NOx class 7 or 8 vehicle, depending on size, ownership, and project type.*
- **Drive Clean! Rebate Program.** *25 percent of total vehicle cost up to \$3,000 to SJV residents and businesses for the purchase of new, clean-air vehicles.*
- **Goods Movement Emission Reduction Projects (Proposition 1B Program).** *Grants up to \$100,000 per heavy-duty natural gas vehicle. Eligible costs include capital costs of purchasing a new vehicle and/or the equipment and installation costs for new fueling infrastructure.*
- **Hybrid and Zero Emission Truck and Bus Voucher Incentive Project (HVIP) – Low NOx Incentives.** *Incentives up to \$45,000 per natural gas vehicle.*
- **National Clean Diesel Funding Assistance Program.** *Incentives up to 45 percent of vehicle replacement costs.*
- **New CNG Infrastructure Program.** *Program under development. Expected to open Q3 2019 and provide incentives for Capital costs associated with purchase and installation of refueling equipment.*
- **Targeted Air Shed Grant Program.** *Up to \$3 million grant funding for the capital costs associated with the purchase/lease of new vehicles and/or refueling infrastructure.*
- **Truck Replacement Program.** *Up to \$100,000 per Natural Gas Truck.*
- **Clean School Bus Rebate Program.** *\$15,000 per Class 3-5 bus and \$20,000 per Class 6-8 bus.*
- **Public Benefit Grant Program – New Alternative Fuel Vehicle Purchase.** *Up to \$20,000 per purchase of new alternative fuel vehicles for public agencies to promote clean air alternative-fuel technologies.*

Non-Energy Value Revenue Incentive Programs

Monetary incentives are also available for the RNG produced that is used for vehicle fuel, as proposed. The revenue generated for these non-energy revenue streams provides a substantial incentive and makes the economics of dairy digester development viable. Given the predicted RNG production rate of 37,200 to 39,500 MCF/year, the volume of RNG used as a transportation fuel, could qualify for LCFS credits and RFS through Renewable Identification Number (RIN) credits. Using the estimated use of RNG of 1,815 MCF/year from the MPT community, the excess RNG for use in the transportation sector would be 35,930-38,230 MCF/year. Based on the 2018 average LCFS credit value of \$160 per metric ton (MT), the LCFS value per MSCF would be \$62.37. This equates to over \$2.2 million dollars a year in LCFS credits. Similarly, RIN credits at \$1.45/RIN would be \$661,876 annually. Leveraging these credits alone would yield a simple payback of less than three years. Figure 5 shows estimated LCFS and RIN credits that could be earned based on historical averages.

Leveraging the grant programs along with the LCFS and RIN credits, the project could have a payback of two to three years. The economics of the cost verses funding and revenue opportunities make this a solid option for providing natural gas to the nearby MPT community.

FIGURE 5
Estimated LCFS and RIN Credits for RNG

Parameter	Units	Value
# of Milking Cows	Cow	1,500
Estimated Annual RNG production ¹²	MCF/yr	37,200
Monterey Park Tract Annual Consumption mscf ¹³	MCF/yr	1815
Amount of RNG for Dairy Usage ¹⁴	MCF/yr	6,657
Amount of RNG to be transported for vehicle fuel	MCF/yr	28,728
# of CNG Tube Trailer Transports Per Year	Tube	89
LCFS Credit Price per Metric Ton Co2 ¹⁵	Dollar/MT CO2	\$160.00
Transported Volume per RNG Tube Trailer	MCF	324
Estimated MPT CNG Station Usage at Dairy	MCF/yr	3650
Estimated Carbon Intensity Score ¹⁶	gCO2e/MJ	-276.24
LCFS Value per MSCF ¹⁷	Dollar/MCF	\$62.37
Carbon Benefit Compared ¹⁸	CO2e/mmbtu	0.39
Annual LCFS Credits Per Year Vehicle Usage		\$2,206,956.70
Federal RIN D Code 3 Credit Price ¹⁹		\$1.45
Federal Rin Production		35385
RIN per mmbtu	Credit/mmbtu	12.9
Annual Federal Rin Credits		\$661,876
Total Annual Credits		\$2,868,833

Consult with TID and CEC

Over the past few months, PG&E has met with both TID and the CEC to discuss the potential for electrification at MPT and to consult on Gas R&D programs. Both organizations were appreciative of the conversations and interested in continuing to discuss potential options that could benefit the community and advance innovative clean-energy solutions. Discussions remain at a high level, at this time, but all parties are open to continuing conversations as more work and analysis is completed.

¹² Based on B&V winter scenario.

¹³ Estimated use based on similar sized homes 5 miles away in Ceres, CA in PG&E gas service territory.

¹⁴ Based on estimated Dairy Annual Diesel Usage gallons.

¹⁵ 2018 average price per LCFS credit.

¹⁶ Estimated Carbon Intensity Score of the Dairy Biogas to CNG pathway was calculated to be -276.24 gCO2e/MJ in the California Air Transportation Board *Staff Summary Method 2B Application: Prospective Pathway Dairy Biogas to CNG, California Bioenergy LLC ("CalBio") Bakersfield, CA* : <https://www.arb.ca.gov/fuels/lcfs/2a2b/apps/calbio-sum-122115.pdf>.

¹⁷ Based on CARB LCFS Credit Calculator v. 1.3 assuming a price of \$160/MT CO2e.

¹⁸ Based on CARB LCFS Credit Calculator v. 1.3.

¹⁹ Historical prices vary and are available at <https://www.epa.gov/fuels-registration-reporting-and-compliance-help/rin-trades-and-price-information>.

Learnings from TID

PG&E has continued conversations with TID since initial outreach with TID staff in 2018 when PG&E was developing our RNG pilot proposal, and consistent with D.18-12-015, those recent conversations have focused on the possibility of a TID electrification option in MPT. In a conversation on April 18, 2019, TID expressed interest in electrification options that could benefit the MPT community. TID's current outreach efforts are occurring in the community to survey households and provide immediate energy cost relief using current TID programs, including weatherization and low-income assistance. Outreach has resulted in a limited response so far, but data gathering from this near-term outreach is intended to inform future efforts being considered. Overall projected costs remain challenging to TID, as costs would be spread over a limited number of customers, but TID is still interested in seeing if any savings can be realized from a future electrification program.

Learnings from CEC

Consistent with the guidance in D.18-12-015, PG&E has met with various sectors of the CEC²⁰ to consult their expertise in both the RNG and possible electrification options being considered for the community. In the initial conversations, PG&E met with CEC teams focused on electrification and gas R&D programs separately due to the distinct differences in the areas of expertise and focus. Both teams were interested in our proposal and CEC staff are pulling together other CEC teams for a follow-up meeting with all the relevant sectors together to provide a more holistic and aligned approach in feedback and consultation to PG&E regarding the opportunities for MPT.

When PG&E's proposal for MPT and the ordering language from D. 18-12-015 was discussed, the CEC noted that it touched many different groups within the CEC and other organizations such as California Air Resources Board (CARB) and the LCFS team, who may have interest in exploring both the RNG proposal and opportunities with TID for electrification. Going forward, the CEC offered to provide information on CEC programs and initiatives that are aligned with our project(s) as well as further consulting support and feedback to help with the project's viability and progress being made, if the MPT community continues to be considered as a pilot community.

²⁰ Meetings with the CEC were held on May 29, 2019 and May 30, 2019.

PG&E Conclusion and Recommendations

PG&E finds the gas microgrid to be the best solution for serving the MPT community based on the further exploration and assessment of costs and timeline to partner with a dairy to provide RNG, and recommends it be approved. Implementing this project would provide the following benefits:

- Provide access to affordable energy options in the MPT community;
- Reduce household energy costs for participating customers;
- Increase health, safety and air quality of the MPT community and surrounding area;
- Provide additional workforce opportunities;
- Additional jobs from construction of the project and maintenance of the digester and biogas cleanup system; and
- Innovative learnings which could be applied to other communities.

Gas microgrids provide significant environmental benefits to local communities through reducing odor, and GHG emissions, improving indoor and outdoor air quality and safety.

From the B&V report PG&E concludes the following:

- PG&E's MPT proposal is a viable project and the preliminary Project schedule shows a duration of 22 months from NTP to Commercial Operation Date, with the possibility of additional time being needed for preliminary engineering or California Environmental Quality Act.
- The capital cost for the Project is expected to be around \$7.2 million – \$9.8 million, depending on the project delivery approach, and B&V recommends the third-party developer approach to greatly reduce capital costs.
- The O&M costs for the Project are expected to be around \$515,000 per year, not including tube trailer transportation.
- Production of RNG using a lagoon digester, membrane-based biogas cleaning system, and on-site CNG refueling station is technically feasible at the scale of interest investigated by B&V and can be reproduced in similarly situated communities.
- Based on the conceptual design for a lagoon digester and RNG production facility at Trinkler, manure from 1,500 milking cows (as well as from 1,380 other cows housed on-site) could produce 37,200 to 39,500 MCF/year of RNG. This is significantly more than what is needed to serve the MPT community estimated usage of 1815 MCF/year and would have broader benefits in the surrounding area with the use of RNG for transportation.
- Beyond the scope of the Phase 2 MPT Gas Microgrid Project, an additional opportunity and potential alternative for MPT would be a pilot program to explore the future use of hydrogen as an energy carrier in domestic applications.

From the GNA report PG&E concludes the following:

- The infrastructure development incentives for the dairy digester and alternative fuel vehicles along with the LCFS and RIN credits make this a viable project with a very attractive economic outlook.

- It would be prudent for Trinkler/developer to apply for all incentive programs that the project is eligible for to help fund the installation of the anaerobic digester, biogas cleanup system, and CNG refueling infrastructure.
- Selling the surplus RNG for use as an alternative vehicle fuel is critical to achieving the full benefits of installing the dairy digester at the dairy. Trinkler and the surrounding community would greatly benefit from the introduction of a CNG fueling station if they leveraged the various incentives available for CNG vehicles.
- The utilization of LCFS and RIN credits when the RNG is used for the transportation sector could significantly off-set the cost of the installation, O&M of the dairy digester, biogas cleaning system, and CNG refueling equipment.

Based on the findings from B&V and GNA, it is clearly evident that the list of incentives and credits make the installation of the dairy digester, biogas clean-up system and CNG refueling system a viable financial investment. The \$7.21 million – \$9.76 million costs could have a payback of less than 3 years.

Additionally, the CEC was supportive of providing consultation to ensure the project provides valuable R&D opportunities that could go above and beyond the SJV DAC objectives. PG&E recommends that the Commission approve the MPT Gas Microgrid pilot to test the concept of using the production of RNG from dairy manure for localized gas distribution networks and transportation applications.

PG&E thanks the Commission for considering this proposal as a gas pilot for the SJV DAC proceeding and looks forward to working with the Commission and other stakeholders on next steps.

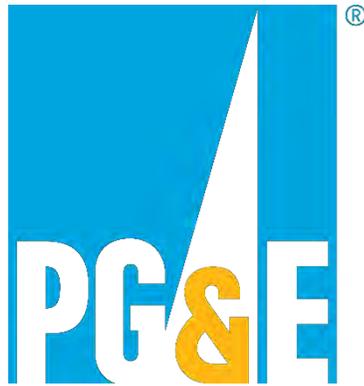
PACIFIC GAS AND ELECTRIC COMPANY
ATTACHMENT A
BLACK & VEATCH REPORT

FINAL – PUBLIC

MONTEREY PARK TRACT GAS MICROGRID RNG DESIGN REPORT

B&V PROJECT NO. 401616
B&V FILE NO. 40.8100

PREPARED FOR



Pacific Gas & Electric Company

7 JUNE 2019



BLACK & VEATCH
 9000 Regency Pkwy, Suite 3000
 Cary, NC 27519
 (919) 462-0250

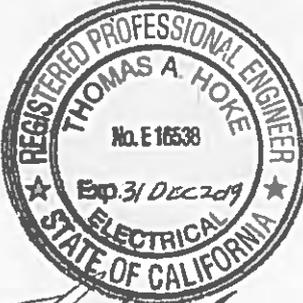
Project Identification		
Title:	PG&E Monterey Park Tract Gas Microgrid	
Address:	Ceres, CA	
Document:	Monterey Park Tract Gas Microgrid RNG Design Report	
Issue Status:	Final Issue	
Certification(s)	<i>Applicable only to sections of document that are not noted as being outside of Black & Veatch's scope</i>	
<p>I hereby certify that this document was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the state of California:</p> <p align="center">Mechanical Engineering</p>  <p><i>Michael Craig Hums</i> 6/6/19</p> <p>Signed: Michael Craig Hums Date: June 06, 2019 Registration No.: M38483</p>	<p>I hereby certify that this document was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the state of California:</p> <p align="center">Electrical Engineering</p>  <p><i>Thomas A. Hoke</i> 06 Jun 19</p> <p>Signed: Thomas A. Hoke Date: June 06, 2019 Registration No.: E16538</p>	<p>I hereby certify that this document was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the state of California:</p> <p align="center">Civil Engineering</p>  <p><i>Cameron L. Bryant</i> 07/JUNE/2019</p> <p>Signed: Cameron L. Bryant Date: June 06, 2019 Registration No.: C63061</p>



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Executive Summary

Black & Veatch has provided conceptual engineering support to Pacific Gas & Electric (PG&E), who is interested in demonstrating a localized gas distribution network using locally-sourced renewable natural gas (RNG). This support included a site visit to a dairy partner's site (as a prospective location for RNG production via anaerobic digestion of dairy manure), establishing a conceptual design basis for the RNG production and distribution operation, preparation of conceptual engineering documentation, conducting a preliminary environmental site assessment, developing capital and operations and maintenance (O&M) cost estimates, and opining on the future potential for renewable hydrogen utilization as part of the "gas microgrid." The gas microgrid project is currently being evaluated by PG&E as part of a proposal submitted to the California Public Utilities Commission (CPUC) to support CPUC's interest in exploring the economic feasibility of various options to bring affordable energy to residents of disadvantaged communities in the San Joaquin Valley in California.

Monterey Park Tract (MPT) is a disadvantaged community (DAC) in San Joaquin Valley (SJV) that is being considered to host the gas microgrid. MPT does not have natural gas and relies on propane fuel for residential uses. As part of the first phase of the program, PG&E would construct and operate the localized gas distribution network at MPT and source fossil-based natural gas from a pipeline interconnection via tube trailer deliveries. The envisioned second phase of the program would include the construction and operation of a dairy manure anaerobic digestion (AD) system at the nearby Trinkler Dairy, located in Ceres, California. The biogas produced from the AD process would then be captured and cleaned to pipeline quality standards, after which the resultant RNG would be piped to MPT, used locally for vehicle refueling, and transported via tube trailer for use at other natural gas refueling stations.

Black & Veatch prepared a design basis memorandum and conducted a site visit to Trinkler Dairy to establish the premise upon which a conceptual design was prepared. A covered lagoon AD system and membrane-based biogas cleaning system were selected for consideration. Manure amounts for summer and winter months were then quantified, after which mass and energy balances were prepared. An RNG production rate of 37,200 to 39,500 thousand cubic feet per year were predicted from this analysis. Engineering documentation, including preliminary process flow diagrams, equipment lists, and site plans, were developed and issued to prospective bidders to obtain budgetary quotes for the digester, biogas cleaning, and refueling subsystems. Based on responses from vendors, Black & Veatch updated engineering documentation and prepared an electrical one-line diagram and load list.

The preliminary environmental site assessment indicated that the project may avoid a lengthy permitting process by requesting a modification to the current dairy farm's Use Permit to include the RNG production and distribution facility. A permitting period of 12 to 15 months is considered likely to obtain the required permits for most biogas upgrading projects within the SJV jurisdiction. Based on the conceptual engineering design package and expected permitting requirements, Black & Veatch developed a schedule that showed a 22-month duration to implement the project including permitting, engineering, procurement, construction, and commissioning. A capital cost estimate range of \$7,209,000 to \$9,761,000 was forecast for the project with the expectation that a developer-led execution approach would likely result in lower costs than a third-party integrator execution approach. O&M costs for the project were estimated to be approximately \$515,000 per year.

Given the increased focus on hydrogen as an environmentally-friendly energy carrier, Black & Veatch reviewed the principal hydrogen production, distribution, and utilization considerations with a focus on the potential insights that a gas microgrid could offer, if some or all of the gas was converted to hydrogen. It was found that MPT, if selected as the beneficiary for the proposed gas microgrid, would serve as an ideal pilot program to study the benefits of hydrogen utilization for domestic applications. Blending of hydrogen with RNG or producing hydrogen from RNG could both be accomplished as an extension of the MPT Gas Microgrid, further adding value to the project as proposed.

1.0 Introduction

1.1 PROGRAM BACKGROUND

PG&E is interested in demonstrating a localized gas distribution network served by PG&E's portable gas service in the MPT DAC of the SJV region of California using locally-sourced RNG. As part of this program, PG&E submitted a proposal to the CPUC in January 2018. Based on the feedback and requested modifications from the CPUC, PG&E modified their offering and submitted an amended proposal in October 2018. In December 2018, the CPUC issued a decision (Rulemaking 15-03-010) to approve various pilot programs, which directed PG&E to refine the costs and projected benefits contained in their amended proposal for the MPT Gas Microgrid Program.

Phase 1 of the MPT Gas Microgrid Program involves the design, construction, and operation of a local gas distribution network with hub to serve the MPT community via a "virtual" pipeline using tube trailers to deliver fossil-based natural gas. Phase 2 involves the design, construction, and implementation of the infrastructure needed to service the MPT gas microgrid with a supply of locally-sourced RNG derived from the AD of dairy manure as well as a refueling station. Black & Veatch was retained by PG&E to provide conceptual engineering and cost estimation services to refine the amended proposal to the CPUC, known herein as the "Project."

1.2 PHASE 2 BUSINESS CASE REVIEW

As part of this Project, Black & Veatch performed an initial review of the business case developed by PG&E. The purpose of this business case review was to clarify the assumptions that went into the initial business case and adjust these assumptions based on the recent work performed by Black & Veatch.

1.2.1 Technical Details

The major subsystems encompassed in the Phase 2 MPT Gas Microgrid would include:

- Dairy manure collection, pre-treatment, and AD.
- Biogas upgrading.
- Point of receipt (POR) station.
- MPT microgrid distribution (installed in Phase 1).
- Compressed natural gas (CNG) refueling.
- CNG tube trailers and pipeline interconnection.

PG&E envisions that the selected farm, Trinkler Dairy in Ceres, California, or other third party would own/operate the dairy manure collection, pre-treatment, AD, and biogas upgrading system. PG&E originally assumed that Trinkler included 1,500 milking cows that could produce RNG at a rate of 28 standard cubic feet (scf) per cow per day, which corresponds to a scrape-type manure collection system. This results in a total estimated RNG production rate of 15,330 thousand cubic feet (MCF) per year (yr).

Black & Veatch surmised that PG&E would own/operate the POR station, on-site CNG refueling, CNG delivery trucks/tube trailers, and interconnections. It was assumed that RNG would be distributed to the MPT community via a metered pipeline after Phase 2 was fully implemented. PG&E further assumed that the balance of RNG produced not used for MPT or on-site refueling would be transported off-site via tube trailers and injected into the same fossil-based transmission pipeline interconnection used to supply MPT in Phase 1. These stations would be owned/operated

by third-party project participants and allow for additional RNG sales into the transportation market. Table 1-1 summarizes the technical details for the Phase 2 MPT Gas Microgrid.

Table 1-1 MPT Gas Microgrid Phase 2 Technical Details

PARAMETER	UNITS	VALUE
MPT RNG Consumption	MCF/yr	1,270
Trinkler Dairy Diesel Fuel Consumption	Gallon/yr	185,000
Trinkler Dairy Diesel to RNG Conversion	%	25
Trinkler Dairy RNG Consumption	MCF/yr	6,657
RNG for Pipeline Injection via Tube Trailer	MCF/yr	7,403
Tube Trailer Capacity	MCF/trailer	324
Annual Tube Trailer Trips	#	23
Total RNG Production	MCF/yr	15,330

1.2.2 Financial Details

Renewable fuel transportation credit inputs used by PG&E include the California Low Carbon Fuel Standard (LCFS) with a pathway carbon intensity (CI) score of -276.24 grams of carbon dioxide equivalent per megajoule and LCFS credit price of \$160 per metric ton. At this CI score and credit price, the resultant LCFS value would be \$62.37/MCF. Presently, PG&E does not include Federal Renewable Fuel Standard (RFS) Renewable Identification Number (RIN) credits as part of their business case for the Project. However, potential revenues from RIN generation were estimated assuming \$1.45/RIN.

Table 1-2 shows the capital costs for the Phase 1 and Phase 2 MPT Gas Microgrid major project elements, estimated by PG&E and reflected in United States (US) dollars (USD). The differences in gas microgrid capital costs between the two phases included land costs, microgrid enclosures, microgrid fencing, and microgrid pad/site improvements.

Table 1-2 MPT Gas Microgrid Phase 2 Capital Costs

PARAMETER	UNITS	VALUE
Phase 1 MPT Gas Microgrid Capital Cost	USD	\$3,843,482
Phase 2 MPT Gas Microgrid Capital Cost ¹	USD	\$4,115,282
Behind the Meter Costs	USD	\$1,110,233
Other Microgrid Costs	USD	\$3,005,049
Phase 2 RNG Production Capital Cost ²	USD	\$2,324,530
Biogas Cleaning System	USD	\$620,000
Refueling System	USD	\$460,000

¹ These costs would be in addition to the RNG Production Capital Cost estimate provided by Black & Veatch in Section 4.2 as part of the SJV DAC proceeding and not the responsibility of the dairy owner.

² These costs exclude digester cost and will be updated by Black & Veatch in Section 4.2.

PARAMETER	UNITS	VALUE
Other Direct Costs	USD	\$1,244,530

1.3 OBJECTIVES

The primary objective of this project is to develop conceptual engineering designs and associated capital and O&M cost estimates for RNG production (and delivery) facilities at a local dairy farm, which can serve the MPT community (Phase 2 of the MPT Gas Microgrid Project). In order to develop these cost estimates, the following tasks have been undertaken:

- Conduct a site visit to Trinkler Dairy to confirm assumptions that would inform the conceptual design basis, environmental/permitting review, and revised business case.
- Establish a conceptual design basis for the RNG production and distribution operation.
- Produce conceptual engineering documentation, including mass and energy balance, process flow diagram (PFD), equipment list, site plan, and electrical load list/one-line diagram.
- Prepare a preliminary environmental site assessment, including preliminary permitting matrix.
- Formulate a project schedule.
- Develop engineering procurement construction (EPC) capital and O&M cost estimates based on the conceptual design.
- Opine on the future potential for renewable hydrogen utilization as part of a gas microgrid.
- Compile the technical and economic findings into a report.

1.4 REPORT ORGANIZATION

Many of the engineering deliverables are included in the appendices of this report with a brief narrative included in the body of the report. Acronyms used throughout the document are included in Appendix A. This report is organized into the following sections:

- Section 2.0 – Engineering.
- Section 3.0 – Project Schedule and Cost Estimates.
- Section 4.0 – Environmental Site Assessment.
- Section 5.0 – Future Hydrogen Utilization.
- Section 6.0 – Conclusions and Recommendations.
- Section 7.0 – References.

2.0 Engineering

2.1 DESIGN BASIS

A Design Basis Memorandum was prepared to define the basis used in engineering/design activities for the MPT Gas Microgrid Project and is attached in Appendix B.

2.1.1 Site Information

Site-specific design criteria were developed using local weather data. It was assumed that existing water sources (i.e. recycled water from wastewater storage lagoons (WWSLs), well water, and irrigation canal) would continue to be used for barn manure flushing, parlor manure flushing, and fire water. The Trinkler Dairy site is located approximately eight miles south of Modesto in the town of Ceres, CA, which is in the SJV. The site address is 7251 Crows Landing Rd. and is located between W. Taylor Rd. to the north and W. Zeering Rd to the south. Major transportation links in the vicinity include California Route 99 to the east and California Route 33/Interstate 5 to the west. Additional site information is detailed in a site visit memorandum included in Appendix C.

2.1.2 Process Design Basis

Table 2-1 and Table 2-2 show the feedstock design basis for Summer and Winter cases, respectively. According to Trinkler Dairy, the capture of milking cow manure is lower in summer and higher in winter, the difference for which is highlighted in red in each table.

Table 2-1 Manure Feedstock Design Basis (Summer)

PARAMETER	UNIT	MILKING COWS	DRY COWS	HEIFERS	CALVES	TOTAL
Count	#	1,500	305	745	330	2,880
Moisture	Wt%	87%	87%	83%	83%	85.51%
Total Solids (TS)	Wt%	13.30%	13.30%	17.10%	16.80%	14.68%
Volatile Solids (VS)	Wt% of TS	85.00%	83.60%	86.60%	86.60%	85.45%
Nitrogen	Wt%	0.66%	0.60%	0.54%	0.74%	0.63%
Phosphorus	Wt%	0.11%	0.08%	0.09%	0.09%	0.10%
Total Manure	lb/day-animal	150	83	48	48	104.83
Total Manure	ft ³ /day-animal	2.4	1.3	0.78	0.78	1.68
Density	lb/ft ³	62.5	63.8	61.5	61.5	62.28
Capture	%	75%	70%	70%	100%	76%
Mass Flow	lb/day	168,750	17,721	25,032	15,840	227,343
Volume Flow	ft ³ /day	2,700	278	407	257	3,642

Table 2-2 Manure Feedstock Design Basis (Winter)

PARAMETER	UNIT	MILKING COWS	DRY COWS	HEIFERS	CALVES	TOTAL
Count	#	1,500	305	745	330	2,880
Moisture	Wt%	87%	87%	83%	83%	85.51%
TS	Wt%	13.30%	13.30%	17.10%	16.80%	14.68%
VS	Wt% of TS	85.00%	83.60%	86.60%	86.60%	85.45%
Nitrogen	Wt%	0.66%	0.60%	0.54%	0.74%	0.63%
Phosphorus	Wt%	0.11%	0.08%	0.09%	0.09%	0.10%
Total Manure	lb/day-animal	150	83	48	48	104.83
Total Manure	ft ³ /day-animal	2.4	1.3	0.78	0.78	1.68
Density	lb/ft ³	62.5	63.8	61.5	61.5	62.28
Capture	%	100%	70%	70%	100%	89%
Mass Flow	lb/day	225,000	17,721	25,032	15,840	283,593
Volume Flow	ft ³ /day	3,600	278	407	257	4,542

Table 2-3 shows the design basis assumptions for raw biogas, dry biogas, off-gas, and RNG.

Table 2-3 Biogas, Off-Gas, and RNG Design Basis

PARAMETER	UNIT	RAW BIOGAS	DRY BIOGAS	OFF-GAS	RNG
Methane	Vol%	65.00%	65.52%	9.26%	96.04%
Carbon Dioxide	Vol%	31.80%	32.06%	88.92%	0.91%
Nitrogen	Vol%	1.90%	1.92%	0%	2.96%
Oxygen	Vol%	0.50%	0.50%	1.25%	0.09%
Water	Vol%	0.60%	0%	0%	≤ 7 lb/MMscf
Hydrogen Sulfide	Vol%	0.20%	0%	0.57%	<4 ppm _v
Total Sulfur	ppm _v	-	-	-	<17 ppm _v
Siloxanes	Mg/Nm ³	-	-	-	0.1
Temperature	°F	-	-	-	60 ≤ T ≤ 100
Dew Point	°F	-	-	-	≤ 45

2.1.3 Process Design Criteria

Black & Veatch selected a covered lagoon digester for this project based on the fact that Trinkler Dairy currently utilizes a flush-type manure collection system and the popularity of such digesters

throughout California. Covered lagoon digesters typically include minimal pretreatment and conditioning of digester influent (i.e. oversized particle or bedding separation) and are unheated. Digestate from the process is typically pumped into a storage lagoon and used as an agricultural fertilizer. Additional AD design criteria are displayed in Table 2-4.

Table 2-4 Anaerobic Digestion Design Criteria

PARAMETER	UNITS	VALUE
Total Solids for Digester Influent	Wt%	<2%
Hydraulic Retention Time	days	55
Organic Loading Rate	lb-VS/1,000-ft ³ /day	10-11
Specific Biogas Yield per Unit Influent	ft ³ /lb-VS	6-8
Specific Biogas Yield per Unit VS Consumed	ft ³ /lb-VS	14-18

PG&E selected a membrane-based biogas cleaning system for this project, which was confirmed to be reasonable by Black & Veatch. It is expected that the system will require upstream capture of hydrogen sulfide using adsorbents to protect downstream process equipment, maintain safety, and meet environmental requirements. The biogas cleaning system will need to include removal of moisture and filtration for particulates but is not expected to require removal of volatile organic compounds (VOCs) and siloxanes.

2.1.4 Discipline-Specific Design Criteria

The Design Basis Memorandum provides several sections focused on engineering discipline-specific design criteria. The Civil/Structural criteria include environmental, design loads, architecture, concrete, steel structures, site, and foundations. The Mechanical criteria include piping, components, accessories, valves, coatings, freeze protection/temperature maintenance, space conditioning, and fire protection. The Electrical criteria include available power, electric motors, emergency systems, hazardous area classification, grounding, lightning protection, lighting, wiring, raceways, plant communications, and freeze protection/temperature maintenance.

2.1.5 Safety Considerations

The use of AD for manure management has a host of environmental benefits compared with typical management practices, but also presents a new set of safety considerations that must be properly managed. The production of biogas via AD results in a number of health and safety risks, including fire/explosion, asphyxiation, toxicity concerns with certain contaminants (i.e. hydrogen sulfide and ammonia), gas/liquid leaks, and biological hazards (i.e. pathogens). Some of these risks exist for a typical manure management system, while others are introduced solely due to the presence of biogas. Proper plant design, construction, commissioning, and operator training is required to minimize the likelihood of incidents occurring as a result of these risks.

2.2 MASS AND ENERGY BALANCE

Black & Veatch prepared a mass and energy balance for the Phase 2 MPT Gas Microgrid Project, which is attached in Appendix D. This analysis covers all process flows (21 total streams) from manure and recycled water inputs to the digester to RNG outputs for various end uses. In instances where information was not immediately available from Trinkler Dairy, Black & Veatch used relevant literature sources to approximate stream characteristics (Summers Consulting LLC, 2013).

The mass balance was primarily compiled using the design basis assumptions and process stream characteristics outlined in Section 2.1.2. A summary of the major elements of the mass and energy balance is shown in Table 2-5.

Table 2-5 Mass and Energy Balance Summary

PARAMETER	UNITS	SUMMER	WINTER
Combined Flow from Barns	lb/hr	110,091	134,700
Influent to Digester	lb/hr	107,130	131,078
Raw Biogas Production	scfm	122.3	115.1
RNG to MPT	scfm	2.5	2.5
RNG to Local Refueling	scfm	13.3	13.3
RNG to Tube Trailers	scfm	63.4	58.7
Total RNG ³	MCF/yr	39,500	37,200

2.3 PROCESS FLOW DIAGRAM

The PFD for the Phase 2 MPT Gas Microgrid Project is included in Appendix E. Major subsystems are broken up by drawing number. Drawing 0100 depicts the digester and shows how existing manure management equipment and WWSLs would interface with the new equipment associated with the AD process. Drawing 0200 shows the biogas cleaning process with the exception of the final RNG compressor. Drawing 0300 includes all RNG handling and distribution equipment, including the refueling station and pipeline to MPT. Drawing 0400 displays the thermal oxidizer system, which is assumed to also serve as a flare when the biogas cleaning system is nonoperational. All numbered streams included in the PFD correspond to the same streams from the mass and energy balance.

2.4 EQUIPMENT LIST

The Phase 2 MPT Gas Microgrid Project equipment list is attached in Appendix F and includes all equipment reflected in the PFDs organized by type and tag number.

2.5 SITE PLAN

The Phase 2 MPT Gas Microgrid Project site plan consists of a general arrangement (GA) drawing (included in Appendix G) for the Trinkler Dairy site showing the major modifications anticipated and new equipment installations/site work planned.

2.6 ELECTRICAL LOADS AND ONE-LINE DIAGRAM

A summary of the electrical load list by major electrical equipment is provided in Table 2-6. Total electric power, given in kilovolt-amperes (kVA) and kilowatts (kW), is reported for each major system. Considering duty cycles, the total required electrical loads are estimated to be

³ These values represent the minimum and maximum annual RNG production rates based on Summer versus Winter digester influent and performance parameters, actual annual production will be in between these values.

approximately 247 kW or 2,056,000 kilowatt-hours per year. The electrical one-line diagram corresponding to these loads is included in Appendix H.

Table 2-6 Summary of Electrical Load List

MAJOR EQUIPMENT NAME	ELECTRICAL LOADS <i>kVA</i>	ELECTRICAL LOADS <i>kW</i>
Rain Water Sump Pump	2.74	3.23
Fire Water Pump	0.00	0.00
Digester Gas Feed Compressor	43.23	50.86
RNG Compressor & Cooler	92.28	108.57
Flare Compressor	6.32	7.43
Flare Fan	1.75	2.05
Miscellaneous	63.00	74.12
TOTAL	209.32	246.26

3.0 Environmental Site Assessment

The construction and operation of an RNG production and distribution facility located at the Trinkler Dairy Farm in Stanislaus County, California, must adhere to relevant environmental and air quality regulations, as administered by the appropriate federal, state and local regulatory authorities having jurisdiction including the San Joaquin Valley Air Pollution Control District (SJVAPCD), the Central Valley Regional Water Quality Control Board (RWQCB) and Stanislaus County. Under these regulations, a facility that has the potential to impact the local environment or emit regulated pollutants must limit these environmental impacts and emissions to permitted levels. This section provides an overview of the relevant environmental and air quality permitting processes that may apply to the development of an RNG production and distribution facility at the Trinkler Dairy Farm. Black & Veatch also developed a table of potential permits and approvals that may be required for an RNG production and distribution facility located in Stanislaus County. The full table is provided in Appendix I, Table I-1.

3.1 PERMITS FOR EXISTING DAIRY FARM

Trinkler Dairy Farm, the planned location for the RNG production and distribution facility, is currently operating under Permits to Operate N-6208-1-2, -2-2, -3-2, -4-2, and -7-1 as issued by the SJVAPCD. The facility requested Authority to Construct (ATC) permits for an expansion of the existing dairy operation and approval was issued on September 12, 2017. At this time, construction for an expansion has not yet begun. Black & Veatch notes that if construction does not commence within two years from the date of issuance of the approvals, the ATCs shall expire. Per Rule 2050, an ATC can be renewed for one additional two-year period if certain conditions are met.⁴

Trinkler Dairy Farm operates under the RWQCB Trinkler Dairy Farm currently has coverage under RWQCB General Order for Existing Milk Cow Dairies Order No. R5-2013-0122 and is in good standing with the RWQCB. Trinkler Dairy Farm has prepared a Nutrient Management Plan and Waste Management Plan for the planned expansion. However, if the RNG production and distribution facility is located on the Trinkler Dairy Farm then they would need to obtain coverage under the RWQCB Order No. R5-2010-0130 Waste Discharge Regulatory Program for Dairy Manure Digester and Co-Digester Facilities.

The Trinkler Dairy Farm has also been approved for a Use Permit from Stanislaus County for the planned expansion but as noted above, construction work for the planned expansion has not yet begun. In its review process Stanislaus County was the lead California Environmental Quality Act (CEQA) agency for the application. The expansion received a Negative Declaration for the project, which means it was found the project would not have a significant effect on the environment. Under Stanislaus County Zoning Ordinance, the inclusion of an RNG production and distribution facility at the site would require a Use Permit and would be subject to a CEQA Review. It is likely that the project would receive a similar Negative Declaration.

3.2 SELECTED PERMITTING ACTIVITIES

The majority of the permits and approvals identified in Appendix I, Table I-1 require a review and approval time of less than 3 to 6 months. In some cases, only notification to the relevant regulatory

⁴ Per Rule 4050, the following three scenarios may warrant the agency granting an extension: The Air Pollution Control Officer (APCO) finds the applicant cannot commence construction because all necessary preconstruction approvals or permits have not been obtained, the APCO finds the facility has experienced an economic downturn, or the ATC is part of a larger project which has commenced construction.

authority is required. However, depending upon facility design and operational parameters, there are some permitting activities that may require 6 to 18 months for review and approval.

Depending on the final design and operational parameters, some requirements of certain permits may be eliminated, or the review time required for permit review may be minimized. With respect to specific permitting activities, Black & Veatch notes the following:

- **US Army Corp of Engineers (USACE) Section 404 Permit and RWQCB 401 Water Quality Certification:** It is assumed that the planned RNG production and distribution facility located at the Trinkler Dairy Farm will be sited to avoid construction near waterways or wetlands. Therefore, it is considered unlikely that the installation of the planned project would require a Section 404 permit or a RWQCB Section 401 Water Quality Certification.
- **CEQA Review:** CEQA review is triggered by the development and use of new lands within the state of California. Since the RNG production and distribution facility will be located at an existing dairy farm and is installed completely within the boundaries of the existing farm, there is a possibility that a CEQA review may not be required. However, according to the Stanislaus County Zoning Ordinance, there is potential that the RNG production and distribution facility would require a Use Permit and undergo a CEQA Review in the process of obtaining that permit. Stanislaus County should be consulted once design and operational parameters are final to confirm whether CEQA review would apply to the project or is not required.
- **Central Valley Regional Water Quality Control Boards National Pollution Discharge Elimination System (NPDES) Discharge Permit:** The RNG production and distribution facility will require the existing Trinkler Dairy Farm NPDES to be modified. The addition of the RNG production and distribution facility would qualify Trinkler Dairy Farm for the RWQCB Order No. R5-2010-0130 Waste Discharge Regulatory Program for Dairy Manure Digester and Co-Digester Facilities. As mentioned in Section 1.1, Trinkler Dairy Farm currently has coverage under RWQCB General Order for Existing Milk Cow Dairies Order No. R5-2013-0122.
- **SJVAPCD ATC Permit (i.e. air permits):** An ATC will be required for each new emission source included in the facility design prior to construction. It is likely that the emission sources associated with the RNG production and distribution facility will be regulated separately from the existing dairy farm (i.e. permitted as a separate facility) due to the facilities falling under different Standard Industrial Classification (SIC) codes and potentially being run by different operators. The bullets below and the permit matrix in Table F-1 provide additional information related to air permitting.
 - If the project exceeds the Best Available Control Technology (BACT) threshold but stays below the New Source Review (NSR) major source thresholds (listed in Table I-1), minor source BACT would apply. In the SJVAPCD, minor source BACT is typically the most stringent emission limit or control technology that is achieved in practice, but economic feasibility is considered. Potential BACT for the thermal oxidizer is also listed in Table I-1.⁵
 - Exceeding the NSR major source thresholds results in additional time and potentially costly analyses/requirements to obtain construction approval, including securing emissions offsets. Lowest Achievable Emission Rate (LAER) technology is

⁵ The thermal oxidizer may not be subject to BACT because it may be classified as an emissions control device.

required for NSR major sources. While BACT in California is often considered as stringent as federal LAER, LAER in California is associated with the most stringent emission limit or emission control achieved in practice.

- Emissions offsets are required for emissions increases of 10 tons per year (tpy) of nitrogen oxides (NO_x) and/or VOCs for projects under the SJVAPCD’s authority. Purchasing emissions offsets in California can represent a significant cost to the project. In addition, the availability of offsets can be limited in this region of the state.
- If the facility’s potential emissions render it applicable as a Title V major source, a Title V operating permit will be required. These operating permits contain monitoring, recordkeeping and reporting requirements that are often more involved than operating permits for minor sources.
- SJVAPCD Rule 4311: Rule 4311 regulates NO_x, VOCs and sulfur oxides (SO_x) emissions from flares installed within the jurisdiction of SJVAPCD. This rule only applies to flares with the potential to emit 10 tpy or more of NO_x and/or VOCs. The rule includes NO_x and VOCs emission limits that vary depending on flare size and design, as displayed in Table 3-1. Source testing, monitoring, recordkeeping and reporting requirements are also included in the rule and may be applicable to the thermal oxidizer being considered for this project.

Table 3-1 Emission Standards for Ground-Level Enclosed Flares ⁶

TYPE OF FLARE AND HEAT RELEASE RATE	VOCs <i>lb/MMBTU</i> ⁷	NO _x <i>lb/MMBTU</i>
Without Steam-Assist		
< 10 MMBTU/hr	0.0051	0.0952
10 – 100 MMBTU/hr	0.0027	0.1330
> 100 MMBTU/hr	0.0013	0.5240
With Steam-Assist		
All	0.14 (as Total Organic Gases) ⁸	0.068

- **SJVAPCD Rule 4570:** Trinkler Dairy Farm is currently subject to Rule 4570 which regulates VOC emissions from Confined Animal Facilities. With the installation of an anaerobic digester, the facility will be required to keep records of design specifications and maintenance logs demonstrating that compliance with Natural Resources Conservation

⁶ Flares that are permitted to operate only during an emergency are not subject to the emission standards in this table.

⁷ Million British Thermal Units (MMBTU)

⁸ All hydrocarbon compounds containing hydrogen and carbon with or without other chemical elements.

Service Field Office Technical Guide Code 366 or 365 is met. The dairy farm will continue to be required to implement mitigation measures as contained in this rule.

- **SJVAPCD Rules 4621 – 4624:** Rules 4621 – 4624 regulate VOC emissions from storage and transfer of organic liquids and gasoline. Depending on the final design of the project, some of these rules may not apply and applicability will need to be revisited. Overall, these rules contain VOC control system requirements, leak inspection requirements, recordkeeping, and testing requirements.

3.3 CONCLUSIONS REGARDING PERMITTING

Permitting of the RNG production and distribution facility, requires permit approvals from multiple regulatory agencies. It is recommended that project developers engage regulatory agencies as early as possible in the development process to identify which permits are required and to determine the length of time needed to acquire all required project permits. Additional conclusions regarding permitting of include the following:

- Since the project site already has a recent CEQA approval the project may avoid a lengthy CEQA permitting process by requesting a modification to the current Use Permit to include an RNG production and distribution facility. If the project is deemed too large for a Use Permit modification then the project may be required to apply for a new Use Permit and a the full CEQA review process, which may require a period of up to 18 months.
- It is possible the project will require installation of equipment that qualifies as BACT. Potential BACT for the thermal oxidizer is included in Table I-1.
- Emissions offsets and air dispersion modeling may be required for this project. The thresholds for triggering these requirements are included in Table I-1.
- If possible, it is advantageous to avoid major source permitting due to the typically longer permit processing times, more costly emission control requirements, and more strenuous operating permit conditions.
- A permitting period of 12 to 15 months is considered likely to obtain the required permits for most biogas upgrading projects within SJVAPCD's jurisdiction. Potential permitting activities that may require 6 to 18 months for review and approval are summarized in Table 3-2.

Table 3-2 Permitting Activities with Review Times of 6 to 18 Months

AGENCY	PERMIT / APPROVAL	REGULATED ACTIVITY	REQUIRED PROJECT PHASE	REQUIRED FOR PROJECT	EXPECTED / TYPICAL REVIEW TIME	COMMENTS
FEDERAL						
USACE	Section 404 Permit	Discharge of dredge or fill material into waters of the US, including jurisdictional wetlands.	Construction	Not Likely	3-6 months for nationwide permit	Unlikely that this will be required for the project based on current site selection.
STATE						
Lead Agency- Stanislaus County	CEQA Review	Land use and development in the state of California.	Construction	Yes	6-18 months	If the project may cause either a direct or indirect impact to the environment and would require the issuance of a permit by one or more public agency, it will be considered a “project” under CEQA and will be subject to review. Extent and length of CEQA review will not be known until final design and operation parameters are established.
RWQCB – Central Valley Regional Water Quality Control Board	RWQCB Order No. R5-2010-0130 Waste Discharge Regulatory Program for Dairy Manure Digester and Co-Digester Facilities	Discharge of waste water from new generation process systems.	Operation	Yes	9-12 months	Trinkler Dairy Farm will need to modify their current permit to receive coverage under this Order.

AGENCY	PERMIT / APPROVAL	REGULATED ACTIVITY	REQUIRED PROJECT PHASE	REQUIRED FOR PROJECT	EXPECTED / TYPICAL REVIEW TIME	COMMENTS
California Environmental Protection Agency (CEPA) – State Water Resources Control Board	Water Use Permit/ Approval	Extraction and use of water.	Operation	Possible	6-12 months	The type of permit or approval will depend on the final site location and final design of the facility. Once those decisions are made, Black & Veatch can assist in determining what agency needs to issue the appropriate approval/permit.
LOCAL						
SJVAPCD	Authority to Construct	Construction of Air Contaminant Sources	Pre - Construction	Yes	Likely 6-12 months if not. Review period may exceed this timeline if the process triggers major source permitting.	BACT required for any source that causes an increase in emissions of an air contaminant greater than 2 lb/day. NSR major source permitting is triggered for projects emitting NO _x and VOCs in excess of 10 tpy, carbon monoxide (CO) in excess of 100 tpy, PM ₁₀ , PM _{2.5} and SO _x in excess of 70 tpy. The purchase of emissions offsets is required for emissions sources with a potential to emit greater than 10 tpy for NO _x /VOCs, 27.38 tpy for SO _x , 14.6 tpy for PM ₁₀ & 100 tpy for CO. An ambient air quality analysis including air dispersion modeling is required for installation of any new emissions source.

4.0 Project Schedule and Cost Estimates

4.1 PROJECT SCHEDULE

A preliminary Level 1 schedule for the Phase 2 MPT Gas Microgrid Project is shown in Figure 4-1. Key milestone dates for major events as part of the execution of this project are listed in Table 4-1 in months after notice to proceed (NTP) through commercial operation date (COD). Given the uncertainty of the execution strategy associated with this project, Black & Veatch has excluded preliminary engineering activities, which could be needed to support permit applications. It may also be possible to use the conceptual design presented herein to obtain the necessary permits. Additionally, the permitting process included in this schedule is somewhat optimistic based on the range of possibilities discussed in Section 3.0.

Table 4-1 Key Milestone Dates

PROJECT MILESTONE	DATE AFTER NTP
Permitting	12 months
Detailed Engineering	13.5 months
Procurement	18 months
Construction	21 months
Commissioning and Testing Completion	22 months
Commercial Operation Date	22 months

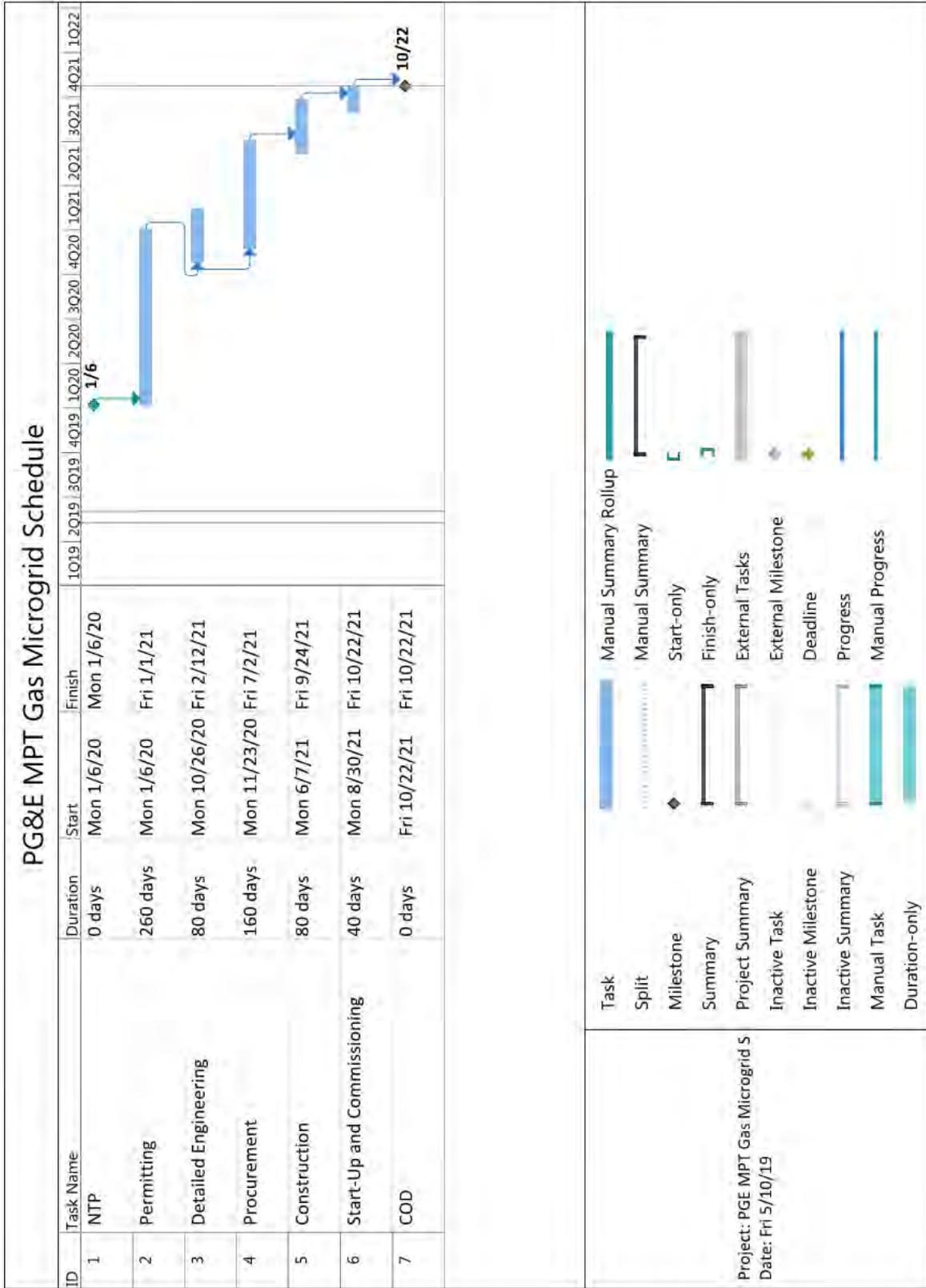


Figure 4-1 Project Schedule

4.2 PROJECT COST ESTIMATES

4.2.1 Cost Estimate Basis

Black & Veatch prepared a conceptual cost estimate that is classified as an American Association of Cost Engineers Class 4 estimate with an accuracy of ± 30 percent. Furnish and erect packages and equipment material prices were estimated primarily using vendor budgetary quotations for the digester, biogas cleaning, and refueling systems. The balance of equipment was estimated using in-house pricing based on historical project data. All costs are expressed in 2019 USD.

Equipment/Key Supplier List

Budgetary quotations were received for the following items based on request for quotation packages prepared by Black & Veatch and attached in Appendix J:

- Anaerobic Digester.
- Biogas Cleaning System.
- Refueling System.

The vendors selected for this project collectively have considerable experience in developing manure digestion projects in California or supplying equipment for such projects.

Civil and Structural

Concrete, rebar, and formwork quantities estimates were based on Black & Veatch internal estimates for BOP and site work. Asphalt pavement quantities were based on new roads depicted in the GA drawing and assuming a 16-inch roadway thickness.

Mechanical and Piping

Mechanical piping and equipment bill of quantities for biogas/RNG piping and fire water supply were determined on the basis of the GA drawing, applicable codes, and tie-in information provided by equipment vendors. Structures have been included for housing certain valves and pumps, as appropriate.

Electrical and Instrumentation

Cables, raceways, and other ancillary electrical supply equipment estimates were based on analogous in-house techniques. Electrical systems for the new equipment (power distribution centers, transformers, etc.) were also estimated on an analogous basis using recent in-house cost data. New instrumentation was included in vendor packages and Black & Veatch assumed that no supervisory control system would be used.

Engineering and Construction

All labor costs have been adjusted to reflect California rates and productivity. The costs reflect an engineering, procurement support, and construction management (EpCM) execution approach. Engineering has been included assuming 24 staff hours per piece of equipment for procurement specifications and 275 staff hours per piece of equipment for BOP. Similarly, construction management costs are estimated assuming 4 staff performing over a 3-month construction period. Construction indirects are estimated at 100 percent of construction labor costs.

Indirects and Exclusions

The capital cost estimate represents an overnight cost with no provisions for escalation. A contractor’s contingency of 5 percent of the total installed cost (TIC) is carried. General liability and builder’s all-risk insurance is estimated as a percentage of TIC. Exclusions from this cost estimate include permitting, capital spares, taxes/duties, liability insurance, letters of credit/bonds, tariff impacts, hazardous materials handling/abatement, and other Owner’s costs.

Developer-Led Capital Cost Estimate

In addition to the EpCM capital cost estimate, Black & Veatch prepared a “developer-led” capital cost estimate. In such a scenario, it is envisioned that a cost savings of approximately 25 to 30 percent could be realized by having a developer lead the execution of the project, rather than a third-party EpCM contractor. The following adjustments to the capital cost estimate were made based such an execution approach:

- Overall reduction in engineering costs (with engineering costs taken out of the digester design and moved to the integrated Engineering budget).
- Reduced labor hours and increased labor efficiency, leveraging the experience and lower blended labor costs with an experienced digester developer team engaged.
- Contingency eliminated from the budget to reflect the lower potential cost range for the project.
- Reduced or eliminated material cost contingencies in several categories associated with no longer having a third-party EpCM integrator.

4.2.2 Capital Cost Estimate

A summary of the capital cost estimate is shown in Table 4-2; the full cost estimate basis and detailed capital cost estimate are attached in Appendix K. The total capital cost for the project is estimated to be in the range of \$7,209,000 to \$9,761,000.

Table 4-2 Capital Cost Estimate

DESCRIPTION	EpCM CAPITAL COST	DEVELOPER-LED CAPITAL COST
Direct Costs		
Site Work	\$835,000	\$835,000
Foundations and Concrete	\$175,000	\$162,000
Steel	\$320,000	\$250,000
Fire Protection System	\$300,000	\$150,000
Lagoon Digester	\$2,279,000	\$1,710,000
Biogas Cleaning System	\$1,925,000	\$1,500,000
Refueling System	\$862,000	\$854,000
Piping	\$460,000	\$130,000
Electrical Equipment and Bulks	\$547,000	\$390,000

DESCRIPTION	EpCM CAPITAL COST	DEVELOPER-LED CAPITAL COST
Insulation and Painting	\$62,000	\$59,000
Productivity Adjustment	\$124,000	\$0
Total Direct Cost	\$7,889,000	\$6,107,000
Indirect Costs		
Construction Management and Startup Staff	\$420,000	\$210,000
Subcontractor Indirects	\$479,000	\$192,000
Engineering	\$508,000	\$700,000
Contingency	\$465,000	\$0
Total Indirect Field Costs	\$1,872,000	\$1,102,000
TOTAL CAPITAL COST	\$9,761,000	\$7,209,000

4.2.3 Operations and Maintenance Cost Estimate

The O&M cost estimates were developed on the basis of the following operational assumptions:

- **Capacity Factor:** The gross capacity factor of the facility is assumed to be 95 percent. Therefore, the plant would be operational for approximately 8,322 hours per year and would be out of service for approximately 438 hours per year.
 - Scheduled maintenance would require 2 weeks per year. This accounts for approximately 340 hours per year of “out-of-service” hours.
 - The remainder of out-of-service hours are allocated for forced outages (e.g. lack of biogas supply, upgrading equipment failures, power outages, etc.).
- **Operational Strategy and Staffing:** The digester, gas cleaning, and refueling systems are assumed to be operated in an unattended manner, with minimal on-site staff required for monitoring and response to alarms.
 - It is assumed that facility staffing would require 2 full time equivalents for on-site monitoring and facility administration.
 - The burdened wage rate for staff is assumed to be \$65,000 per year.
- **Adsorbent Media Costs:** H₂S adsorbent media costs were estimated assuming a cost of \$4.15 per pound of sulfur captured, based on in-house Black & Veatch data.
- **Cost of Utilities:** The cost of electricity, water and natural gas are based on estimates of current market rates in California.
 - The cost of electricity is assumed to be \$0.11 per kilowatt-hour.
 - The cost of water is assumed to be \$10.00 per 1,000 gallons.
 - The cost of propane is assumed to be \$1.00 per gallon.

All O&M cost estimates are presented in 2019 USD. The estimated annual non-fuel O&M costs are summarized in Table 4-3 and are estimated at \$515,000 per year.

Table 4-3 O&M Cost Estimate

DESCRIPTION	TOTAL COST
H ₂ S Removal Media Replacement	\$43,000
Biogas Conditioning / Upgrading System Maintenance	\$51,000
Refueling System Maintenance	\$20,000
Electric Power	\$205,000
Water Requirement	\$0
Propane for Thermal Oxidizer	\$19,000
Labor	\$130,000
Contingency (10% of Subtotal)	\$47,000
TOTAL O&M	\$515,000

5.0 Future Hydrogen Utilization

Hydrogen is the most abundant element in the universe and its potential as a clean energy source both for transportation and domestic usage is being pursued by countries around the world. Australia and the city of Leeds, England both have programs to expand the use of hydrogen in domestic applications above and beyond a plurality of advanced economies that have been expanding hydrogen transportation programs. There is already a significant worldwide market for hydrogen. Hydrogen is primarily produced at scale today using steam reformation of fossil gas and as part of the refining process. However, to better address climate change, there are new production technologies for hydrogen that offer considerable promise.

California is in early stages of exploring the use of Hydrogen as a clean fuel source that can help meet California's Climate goals. Hydrogen production through electrolysis (power to gas) and biomass gasification offer potential solutions for the current obstacles in California's current state regarding climate: over production of renewable electricity and reducing wildfire risk. However, additional research and development is needed before California can adopt standards for using Hydrogen in domestic, commercial, and industrial uses.

Uses of hydrogen are growing but significant challenges remain, particularly with respect to distribution infrastructure. The proposed MPT Gas Microgrid offers an ideal pilot program to better understand the multi-faceted potential for hydrogen. The following subsections outline the current state-of-the-art and research needs in hydrogen production and usage, as well as the manner in which MPT could serve as a test bed to address issues associated with these topics.

5.1 SUITABILITY OF MPT FOR FUTURE HYDROGEN UTILIZATION

MPT could be used as a real world testing ground for hydrogen production and utilization, which would continue to position California as a world leader in addressing hydrogen, helping to advance the tremendous potential of this clean energy source. Key characteristics of the proposed MPT Gas Microgrid project that could fit into a hydrogen production and utilization approach including the following:

- MPT could use the RNG derived from the Phase 2 Project to produce hydrogen on-site.
- Electrolyzers could be installed to produce hydrogen for use in the MPT Gas Microgrid.
- The fueling infrastructure at MPT/Trinkler could also potentially be used to dispense hydrogen or hydrogen/RNG blends.
- An investigation of how to blend/extract hydrogen from the pipeline at MPT would be appropriate for its small scale.
- The performance of different appliances could also be an ideal study for the MPT community.
- Considering the impact to pipelines and costs/benefit of dedicated hydrogen pipes would be the focus of many of the proposed studies.

5.2 HYDROGEN UTILIZATION

5.2.1 Distribution

Hydrogen can be distributed in high-pressure, compressed gas tube trailers, cryogenic liquefaction systems, and pipelines. Most infrastructure studies have concluded that a pipeline network is the optimal long-term solution for hydrogen distribution. A pipeline network is scalable to handle large volumes within a populated area, will benefit from cost reductions with economies of scale, and can utilize geophysical storage. To date, most policy support and development efforts have been focused on hydrogen refueling stations for fuel cell electric vehicle (FCEV) transportation applications. This policy support is driving early consumer adoption of FCEVs and facilitating the advancement of the infrastructure supply chain, including compressed/liquefied hydrogen transmission and storage technologies. Approximately 80 percent of the current cost for dispensed hydrogen is due to the transportation, delivery, and refueling station costs (i.e. \$2 per kilogram [kg] production, \$3/kg transport and delivery, and \$5/kg refueling station for a total indicative cost of \$10/kg).

Blending hydrogen into existing natural gas pipeline networks has been considered, and concentrations of less than 5 to 15 percent hydrogen by volume appears to be viable with little changes to the existing natural gas transmission/distribution infrastructure and end-use appliances. However, any blend would require extensive studies and testing as well as modifications to the monitoring and maintenance practices of the existing infrastructure. Pure hydrogen can be delivered to markets using natural gas pipeline blended by using separation and purification technologies that would extract hydrogen from the natural gas blend close to the point of end use.

While using blended gas networks would avoid the cost of building dedicated hydrogen pipelines, it introduces additional costs to blend and extract the gases, as well as any infrastructure modifications required. Integrity management of blended pipelines will likely require increased costs due to additional leak detection systems and higher inspection frequencies. Gas leakage from pipelines is considered to be economically negligible; however, leakage due to seals at joints requires additional study, specifically in regard to leakage into confined spaces (National Renewable Energy Laboratory, 2013).

According to the Australian Commonwealth Scientific and Industrial Research Organization (CSIRO), the transport of 100 percent hydrogen via pipeline raises pipe embrittlement concerns, depending on the operating pressure and pipeline material of construction. The risk of embrittlement in domestic gas distribution networks is lower due to the lower operating pressures verses higher pressures of the transmission networks.

5.2.2 Domestic Usage

A study conducted by NaturalHy concluded hydrogen concentrations up to 28 percent (in natural gas) can be used with properly serviced domestic appliances, but that the impacts of using blended gas for industrial applications should be considered on a case-by-case basis (National Renewable Energy Laboratory, 2013). R&D investment priorities for hydrogen use in domestic applications include:

- Development of odorants that can be blended with hydrogen for leakage detection, as conventional natural gas odorants (i.e. sulfur-containing) could potentially contaminate appliances such as fuel cells.

- Flame enhancement additives may be required to ensure a visible flame.

The Australian Hydrogen Roadmap references the HyDeploy project in the United Kingdom, which suggests a hydrogen in natural gas concentration up to 20 percent by volume can be tolerated by conventional appliances (Australian CSIRO, 2018). Not long after the publication of this report, a trial was announced by Australian Renewable Energy Agency for the blending of hydrogen (at small percentages) into a local gas pipeline in western Sydney to demonstrate the concepts explored in the report (Zhou, 2018). Such a program would build upon the H21 Leeds City Gate project, which is targeting the conversion of its natural gas network to pure hydrogen by the 2030s and serve a community of 660,000 residents with decarbonized domestic heating fuel.

The ability of residential appliances to operate on blended natural gas and hydrogen without upgrades could allow a flexible rollout of decentralized hydrogen production, noting that an extensive rollout of hydrogen production (in Australia) is unlikely to occur prior to 2030. It is noted that to accommodate 100 percent hydrogen, existing residential appliances would need to be upgraded or replaced, and that the required design changes are relatively straight forward. Design changes for commercial and industrial applications are considered to be complex and would need to be evaluated on a case-by-case basis. It is suggested that the replacement of domestic appliances would be preferred to upgrading existing appliances, which is considered to be time consuming and expensive. Also noted is the option to replace natural gas appliances with electric appliances to be powered by domestic fuel cell combined heat and power (CHP) systems.

5.2.3 Transportation Fuel Usage

According to the California Air Resources Board (CARB), there are 36 Open-Retail hydrogen fueling stations across the state of California, which is expected to grow to 64 stations by the end of 2020 and 200 stations by 2025. CARB suggests that as more FCEVs are deployed, the refueling station network utilization rate will also increase, which will improve the business case for the Open-Retail stations (California Air Resources Board, 2018). The majority of refueling stations in California receive hydrogen via compressed gas deliveries (54 percent), on-site electrolysis (20 percent), or liquefied deliveries (18 percent), with total hydrogen dispensed across all stations at approximately 1,000 kg/day (National Renewable Energy Laboratory, 2019).

Light-duty FCEVs are considered to be mature and ready for mass-market deployment. CARB projects that the number of FCEVs in California will grow to 40,000 by 2024, and 300,000 by 2030. Strong global developments in FCEVs, stationary power, and other applications are projected to stimulate further technology improvements and drive down costs with mass production. The growth of the FCEV market is currently limited by fuel supply challenges including a lack of refueling stations, high hydrogen retail prices, and unreliable supply.

The advancement of medium-duty and heavy-duty FCEVs, which are currently in the prototyping stage of technology readiness, is expected to provide additional hydrogen demand growth. Refueling times ranging from 3 to 5 minutes and vehicle driving range exceeding 350 miles makes FCEV technology more competitive than Battery Electric Vehicle technology to replace diesel in these applications. A hydrogen-fueled fuel cell tractor by Nikola Motor shows promise in the heavy-duty fuel cell vehicle arena. The newly-unveiled Nikola hydrogen powered tractors already have more than 13,000 orders. The trucks have a range between 500 and 750 miles and a refueling time of less than 20 minutes. Additionally, Nikola Motor has a powersports division developing off-road vehicles and watercraft based on FCEV technology (Nikola Motor Company, 2019). Other companies advancing heavy-duty FCEV technology include Toyota, Kenworth, and Hyundai.

Noteworthy industrial applications for fuel cell technology include forklift trucks, distributed power generation/CHP, and energy storage. Fuel cell forklifts have been deployed throughout the country with little government incentives and are considered advantageous for their quick refueling times, small footprint, and lack of harmful emissions compared with battery- and engine-driven counterparts. The California Fuel Cell Partnership (CAFCP) estimates that more than 500 fuel cell forklifts have been deployed in the state, indicating the technology is fully mature.

Fuel cells have been used extensively for stationary power generation/CHP over decades with molten carbonate, phosphoric acid, and solid oxide technologies dominating the market. The CAFCP estimates that over 200 megawatts of stationary fuel cells have been deployed across the state, most of which are fueled by natural gas. With higher penetration of renewables, the need for seasonal energy storage becomes imperative. Hydrogen energy storage via electrolysis and fuel cells is a relatively immature application due to high costs, but the constituent technologies are considered advanced.

5.3 HYDROGEN PRODUCTION

Hydrogen is an energy carrier that can be produced from a wide variety of primary energy sources and used in a host of commercial and industrial applications. The US produces approximately 10 million metric tons (MMT) of hydrogen per year with worldwide annual hydrogen production estimated to be between 61 and 65 MMT. Approximately 60 percent of the hydrogen production in the US is done so on-site for use in petroleum refining and ammonia/methanol production. The remaining 40 percent is produced, shipped, and sold as an industrial gas in a variety of applications.

The US Department of Energy (DoE) supports a wide range of hydrogen production technologies having recently concluded research and development (R&D) efforts for hydrogen generation via steam methane reforming (SMR) and biomass gasification. Hydrogen generation via electrolysis is also considered a near-term technology; however, current R&D efforts are focused on lowering the cost of commercial systems. Mid- and long-term DoE hydrogen production pathways include reforming of liquid biofuels, microbial biomass conversion, novel electrolysis technologies, coal gasification with carbon capture and storage, photo-electrochemical water splitting, solar thermochemical, and photo-biological technologies (US Department of Energy, 2016).

According to the US DoE Fuel Cell Technologies Office (FCTO) Multi-Year Program Plan, DoE's primary goal is to reduce the cost of production of hydrogen, independent of technology pathway, to less than \$2 per gallon of gasoline equivalent (GGE) and to less than \$4/GGE delivered and dispensed (US Department of Energy, 2015). The DoE FCTO H2@Scale initiative extends the focus beyond transportation applications and funds R&D projects to address other industrial and domestic applications for hydrogen with a focus on infrastructure and end-use technologies (US Department of Energy, 2019).

5.3.1 Steam Methane Reforming

Hydrogen production via steam methane reforming (SMR) is considered a mature, commercialized technology. Fossil-based natural gas or RNG is combined with high-pressure steam and fed to a steam reforming reactor. The endothermic SMR reaction converts methane and steam over a catalyst into hydrogen and CO, also known as synthesis gas or syngas, which is further processed through a series of high- and low-temperature water gas shift (WGS) reactors to convert most of the remaining CO into hydrogen and carbon dioxide. A pressure swing adsorption (PSA) process is then used to separate the hydrogen from the remaining CO and methane and compress the gas to a suitable pressure for delivery and end use.

SMR is highly sensitive to the cost of natural gas feedstock, thus low-cost, fossil-based resources are often favored over RNG. Black & Veatch estimates the levelized cost of hydrogen to be in the range of \$1 to \$3/kg) corresponding to natural gas priced at \$3 to \$7/MMBTU. Current SMR R&D activities include:

- Development of new, economical catalysts and membranes that can operate at higher temperatures and pressures and facilitate improved conversions and product purity, respectively.
- Further development of structured and multilayered adsorbents will allow for further improvements to current PSA processes allowing for shorter cycle times and higher production rates.
- Process intensification, specifically the integration of the reforming, WGS, and separation unit operations.
- Further development of reforming catalysts, WGS catalysts, PSA adsorbents, separation membranes, and separation processes can continue to improve overall pathway efficiencies and reduce production costs.

5.3.2 Electrolysis

Hydrogen produced via electrolysis uses electricity to split water molecules into hydrogen and oxygen gases in a stack of electrochemical cells. Electrolysis is considered commercial at a small scale; however, there are challenges for the technology with respect to scale-up and realization of economies of scale. There are several different types of electrolyzer technologies, with alkaline and proton exchange membrane (PEM) technologies being considered the most prominent. Alkaline electrolysis is characterized as being durable, having relatively low capital costs due to the lack of noble metal electrocatalysts, and is based on technology dating back to the 1920s, thus is quite mature. PEM electrolyzers have high power density and flexible turn-down ratios, but currently demonstrate lower lifetimes and have higher complexity than alkaline.

As electrolysis uses electricity to generate hydrogen it is sensitive to the cost of electricity. Black & Veatch estimates the levelized cost of hydrogen via electrolysis to be in the range of \$6 to \$9/kg corresponding to electricity priced at \$0.08 to \$0.12 per kilowatt-hour. Current electrolysis R&D activities include:

- Component standardization and manufacturing scale-up for PEM electrolysis.
- Lower catalyst loadings, thinner membranes, and alternative bipolar plate materials of construction.
- System-level integration, process intensification, and water/hydrogen purification technologies.

5.4 CONCLUSIONS REGARDING HYDROGEN

The following conclusions are noted with respect to the potential for hydrogen utilization at MPT:

- Hydrogen is produced primarily via SMR and water electrolysis at a cost of around \$1-\$3/kg and \$6-\$9/kg, respectively.
- Hydrogen is distributed to end users primarily via compressed gas tube trailer, liquefied containment, or pipelines.

- Blending of hydrogen into existing natural gas supply infrastructure is considered feasible in the near term but will require modifications to existing monitoring and maintenance practices.
- The use of hydrogen in domestic applications is constrained primarily by safety and cost considerations, with more focus applied to distributed fuel cell power generation and usage of electric appliances, rather than replacing natural gas fueled appliances with those fueled by hydrogen.
- The use of hydrogen in light-duty FCEVs, forklifts, and for stationary power/CHP applications has matured extensively and is expected to continue to grow over the next few decades.
- Medium- and heavy-duty FCEVs are currently being prototyped and offer promise to increase demand for hydrogen as a transportation fuel.
- Similar to the City of Leeds, which plans to switch its entire natural gas distribution and utilization infrastructure to hydrogen, a plan could be developed and implemented to have the MPT community (and the associated residential appliances) changed over to be supplied with hydrogen in the future, rather than with RNG or natural gas.
- If a design change is made to shift from supplying RNG to 100 percent hydrogen, key issues to note include the following:
 - Replacement of major components within appliances may be required, potentially warranting procurement of new appliances altogether.
 - Assuming elastomeric materials typical of the natural gas industry are used in distribution lines, hydrogen should be compatible with these materials at low pressures.
 - Distribution meters should be able to be reused but would need to be calibrated for hydrogen.

6.0 Conclusions

Based on the findings of this study, Black & Veatch has developed the following conclusions and recommendations. These should be considered as PG&E continues to pursue the company's objectives regarding the production of RNG from dairy manure and utilization for transportation applications and localized gas distribution networks.

- Production of RNG using a lagoon digester, membrane-based biogas cleaning system, and on-site CNG refueling station is considered technically feasible at the scale of interest investigated by Black & Veatch.
- Black & Veatch established a conceptual design for a lagoon digester and RNG production facility at the Trinkler Dairy. The design indicated that manure from 1,500 milking cows (as well as from 1,380 other cows housed on-site) could produce 37,200 to 39,500 MCF/yr of RNG, well in excess of that predicted by PG&E in their business case for the Project.
- A preliminary permitting investigation found that the project may avoid a lengthy CEQA permitting process by requesting a modification to the current Use Permit to include an RNG production and distribution facility. If possible to install BACT equipment, it is advantageous to avoid major source permitting. A permitting period of 12 to 15 months is expected for the Project.
- The preliminary Project schedule shows a duration of 22 months from NTP to COD, including permitting, detailed engineering, procurement support, construction, and start-up/commissioning. An additional phase of preliminary engineering may be needed to prepare permit applications, and additional time for permitting may be needed as well.
- The capital cost for implementation of the Project is estimated to be in the range of \$7.2 million to \$9.8 million; where a developer-led approach is anticipated to be in the lower cost range, and an EpCM implementation approach is anticipated to be in the higher cost range for implementation of the Project.
- The O&M costs for the Project are expected to be around \$515,000 per year, not including tube trailer transportation, which is also higher than that predicted by PG&E primarily due to higher electricity consumption.
- Beyond the scope of the Phase 2 MPT Gas Microgrid Project, Black & Veatch finds that MPT represents an attractive opportunity for a pilot program to explore the future use of hydrogen as an energy carrier in domestic applications.

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Appendix A. Acronyms

AD	Anaerobic Digestion
APCO	Air Pollution Control Officer
ATC	Authority to Construct
BACT	Best Available Control Technology
CARB	California Air Resources Board
CAFCP	California Fuel Cell Partnership
CEPA	California Environmental Protection Agency
CEQA	California Environmental Quality Act
CHP	Combined Heat and Power
CI	Carbon Intensity
CNG	Compressed Natural Gas
CO	Carbon Monoxide
COD	Commercial Operation Date
CPUC	California Public Utilities Commission
CSIRO	Commonwealth Scientific and Industrial Research Organization
DAC	Disadvantaged Community
DoE	Department of Energy
EPC	Engineering, Procurement, Construction
EpCM	Engineering, Procurement Support, Construction Management
FCEV	Fuel Cell Electric Vehicle
FCTO	Fuel Cell Technologies Office
GA	General Arrangement
GGE	Gallons of Gasoline Equivalent
kg	Kilogram
kW	Kilowatts
LAER	Lowest Achievable Emission Rate
lb	Pounds
LCFS	Low Carbon Fuel Standard
MCF	Thousand Cubic Feet
MMBTU	Million British Thermal Units
MMT	Million Metric Tons
MPT	Monterey Park Tract
NO _x	Nitrogen Oxides
NPDES	National Pollution Discharge Elimination System
NSR	New Source Review
NTP	Notice to Proceed
O&M	Operations and Maintenance
PEM	Proton Exchange Membrane
PFD	Process Flow Diagram
PG&E	Pacific Gas & Electric
POR	Point of Receipt
ppm	Parts per Million
PSA	Pressure Swing Adsorption
R&D	Research and Development
RFS	Renewable Fuel Standard
RIN	Renewable Identification Number
RNG	Renewable Natural Gas

RWQCB	Regional Water Quality Control Board
scf	Standard Cubic Feet
scfm	Standard Cubic Feet per Minute
SIC	Standard Industrial Classification
SJV	San Joaquin Valley
SJVAPCD	San Joaquin Valley Air Pollution Control District
SMR	Steam Methane Reforming
SO _x	Sulfur Oxides
TIC	Total Installed Cost
tpy	Tons per Year
TS	Total Solids
US	United States
USACE	US Army Corp of Engineers
USD	US Dollar
VOC	Volatile Organic Compound
VS	Volatile Solids
WGS	Water Gas Shift
WWSL	Wastewater Storage Lagoon
yr	Year

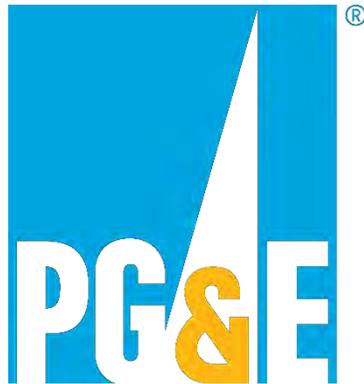
Appendix B. Design Basis Memorandum

FINAL

MONTEREY PARK TRACT GAS MICROGRID DESIGN BASIS

B&V PROJECT NO. 401616
B&V FILE NO. 40.0100

PREPARED FOR



Pacific Gas & Electric Company

20 MAY 2019



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1.0 General Information

Client’s Name: Pacific Gas & Electric Company (PG&E)
Facility Location: Ceres, California (CA), USA
Unit Type: Renewable Natural Gas (RNG) Production and Distribution Facility

1.1 OBJECTIVE

The purpose of this document is to:

- Define the basis used for designing the RNG Production and Distribution Facility to serve the Monterey Park Tract (MPT) Gas Microgrid.
- Record input information received from the Client that will be used in the preparation of the design.

1.2 SCOPE

Black & Veatch is assisting with the design and development of an RNG Production and Distribution Facility that will receive manure from dairy cows, anaerobically digest the manure to produce biogas, and upgrade the biogas to RNG for distribution to multiple end users, including the MPT community. Black & Veatch’s scope is to develop a conceptual design and cost estimate for the facility in cooperation with PG&E, Trinkler Dairy, and other stakeholders.

1.3 UNITS

Variables and engineering units to be used for this project are shown in Table 1-1.

Table 1-1 Variables and Engineering Units

Variable	Engineering Units
Temperature	°F
Pressure	
Near Atmosphere	psig
Above Atmosphere	psig
Below Atmosphere	in H ₂ O
Absolute	psia
Level	
Process	ft, inches
Storage tanks	ft, inches
Flow	
Gas Volume	SCFM
Gas Mass	lb/hr
Liquid Volume, Process flows	GPM
Liquid Volume, Utility flows	GPM
Liquid Mass	lb/hr
Solid Mass	lb/hr, tons/hr (tph)

Variable	Engineering Units
Electrical	
Voltage	V
Real power	W
Apparent power	VA
Motor power output	HP
Frequency	Hz
Distance	ft, inches
Velocity	ft/s, ft/min
Length	ft
Thermal Conductivity	BTU/(hr ft °F)
Gross Heating Value	BTU/lb
Net Heating Value	BTU/lb
Density	lb/ft ³
Weight	lb, tons
Soil Bearing Pressure	psf
Heat/Thermal Duty	MMBTU/hr
Sound Pressure Level	dBA

1.4 DESIGN CODES AND STANDARDS

The design and specification of work will be in accordance with applicable state and federal laws and regulations, and local codes and ordinances. The codes and industry standards used for design, fabrication, and construction are listed below and will be the editions in effect, including all addenda. Other recognized standards may also be used as design, fabrication, and construction guidelines when not in conflict with the listed standards. Applicable codes shall be finalized during detailed design:

- American Concrete Institute (ACI).
- American Institute of Steel Construction (AISC).
- American Iron and Steel Institute (AISI).
- American National Standards Institute (ANSI).
- American Petroleum Institute (API).
- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- American Society of Mechanical Engineers (ASME).
- American Society for Testing and Materials (ASTM).
- American Water Works Association (AWWA).
- American Welding Society (AWS).
- Applicable California Building Code.
- Applicable California Plumbing Code.
- Cooling Tower Institute (CTI).
- Compressed Gas Association (CGA).
- Concrete Reinforcing Steel Institute (CRSI).
- Environmental Protection Agency 40 CFR Part 60 and 40 CFR Part 75 (EPA).
- Illuminating Engineering Society (IES).
- Institute of Electrical and Electronics Engineers (IEEE).
- International Organization for Standardization (ISO).

- International Society of Automation (ISA).
- Insulated Cable Engineers Association (ICEA).
- National Electric Code (NEC).
- National Fire Protection Association (NFPA).
- National Institute of Standards and Technology (NIST).
- Occupational Safety and Health Administration (OSHA).

2.0 Site Information

2.1 SITE CONDITIONS

Site-specific design criteria are shown in Table 2-1.

Table 2-1 Site-Specific Design Criteria

Design Barometric Pressure:	14.66 psia ^[NOTE 1]
Elevation:	73 ft
Design Minimum Ambient Temperature:	20 °F ^[NOTE 1]
Design Maximum Ambient Temperature (dry bulb):	113.6 °F ^[NOTE 1]
Design Maximum Ambient Temperature (wet bulb):	79.3 °F ^[NOTE 1]
Notes:	
1. Based on ASHRAE HVAC design data for 724926 weather station.	

2.2 DESIGN BASIS WATER

The well water and surface water used currently for dairy operations/irrigation should suffice and will have no impact on water quality requirements for the anaerobic digestion process.

2.3 ENVIRONMENTAL EMISSIONS AND EFFLUENTS

A permit has not been obtained yet for the site to host an RNG Production and Distribution Facility but will be evaluated as part of this study. Air emissions are expected from the emergency flare and thermal oxidizer for biogas upgrading off-gas streams. Liquid effluents are expected from anaerobic digestion include digestate, which is expected to be recirculated/field-applied. Both streams will be characterized as part of the design effort.

2.4 NOISE LIMITATIONS

The near-field noise emissions for each equipment component furnished shall not exceed a spatially-averaged, free-field, A-weighted sound pressure level of 85 dBA (referenced to 20 micropascals) measured along the equipment envelope at a height of 5 ft above floor/ground level and any personnel platform during normal operation. The equipment envelope is defined as the perimeter line that completely encompasses the equipment package at a distance of 3-ft horizontally from the equipment face.

Where the drive motors, variable frequency drives (VFDs), or mechanical drives for the equipment are also furnished, the total combined near-field sound pressure level of the motor, VFD, or mechanical drive and the driven equipment measured as a single component, operating at design load, shall not exceed a spatially-averaged, free-field, A-weighted sound pressure level of 85 dBA (referenced to 20 micropascals) measured along the equipment envelope.

During off-normal and intermittent operation such as start-up, shut-down, and upset conditions the equipment sound pressure level shall not exceed a maximum of 110 dBA at all locations along the equipment envelope, including platform areas, that are normally accessible by personnel.

2.5 SITE ACCESS

The Trinkler Dairy site is located approximately eight miles south of Modesto in the town of Ceres, CA, which is in the San Joaquin Valley (SJV). The site address is 7251 Crows Landing Rd. and is

located in between W. Taylor Rd. to the north and W. Zeering Rd to the south. Major transportation links in the vicinity include California Route 99 to the east and California Route 33/Interstate 5 to the west.

3.0 Utility Requirements

Utilities required for the facility are shown in Table 3-1.

Table 3-1 Utility Requirements

Utility	Utility Supply Information
Nitrogen	Bottles housed on-site for purging
Instrument Air	Expected to be used for control valves as part of biogas cleaning process, requirements to be defined by vendor
Process Water (non-potable)	Sourced from well and/or surface channel
Propane	Tank housed on-site for boiler gas, flare/oxidizer, and potentially heating for biogas cleaning process
Electrical Power Supply	Provided by Turlock Irrigation District (TID) Water & Power from local distribution circuit

4.0 Process Design Basis

4.1 PROCESS DATA TABLES

4.1.1 Feedstock

Table 4-1 shows the dairy manure feedstock basis. Manure and dilution water (i.e. digester influent) mass flow rates to be defined as part of mass balance task.

Table 4-1 Feedstock Design Basis ¹

Parameter	Unit	Milking Cows	Dry Cows	Heifers
Moisture	Wt%	87	87	83
Total Solids (TS)	Wt%	13.3	13.3	17.1
Volatile Solids (VS)	Wt% of TS	85	83.6	86.6
Nitrogen	Wt%	0.66	0.6	0.54
Phosphorus	Wt%	0.11	0.08	0.09
Total Manure	lb/day-animal	150	83	48
Total Manure	ft ³ /day-animal	2.4	1.3	0.78

4.1.2 Digestate Composition

Digestate characteristics and flow rates to be defined as part of mass balance task.

4.1.3 Biogas Composition

Table 4-2 shows the expected biogas composition.

Table 4-2 Biogas Design Basis

Parameter	Unit	Value
Methane	Vol %	65
Carbon Dioxide	Vol %	32
Nitrogen	Vol %	1.9
Oxygen	Vol %	0.5
Water Vapor	Vol %	0.6
Hydrogen Sulfide	ppmv	2,000

4.1.4 RNG Composition

Table 4-3 shows the expected RNG composition.

¹ Moisture, TS, VS, Nitrogen, Phosphorus, and Total Manure all based on American Society of Agricultural and Biological Engineers Standard D384.2

Table 4-3 RNG Design Basis ²

Parameter	Unit	Value
Methane	Vol %	TBD
Oxygen	Vol %	≤0.1
Nitrogen	Vol %	TBD
Carbon Dioxide	Vol %	≤1
Total Sulfur	ppm _v	≤17
Hydrogen Sulfide	ppm _v	≤4
Water Vapor	lb/MMSCF	≤7
Siloxanes	mg/Nm ³	0.1
Temperature	°F	60 ≤ T ≤ 100
Dew Point	°F	≤45
Heating Value	BTU/SCF	TBD
Wobbe Index	BTU/SCF	TBD

4.2 DESIGN CRITERIA

4.2.1 Anaerobic Digestion

The anaerobic digestion of dairy manure is typically performed in a covered lagoon for flush-type collection systems or a mixed plug-flow digester for scrape-type collection. The dairy manure digester process for a flush-type manure collection system (used at Trinkler Dairy) can be broken up into the following process steps:

- **Waste Reception:** Fresh manure and recycled flush water is pumped, hauled, or drained via gravity to a receiving pit.
- **Mechanical Pretreatment and Conditioning:** Mechanical pretreatment and conditioning may or may not be performed prior to digestion (e.g. sand separation between receiving pit and digester).
- **Anaerobic Digestion:** Manure is pumped from the receiving pit to the mixed or un-mixed and typically unheated digester. For most flush-type manure systems, a below-grade, covered lagoon is typically used. After digestion, the digestate is pumped to the storage lagoon.
- **Dewatering:** The digestate is typically used as agricultural fertilizer. A portion of the digestate may also be used as recycled flush water.
- **Biogas Utilization:** The produced biogas is sent to the cleaning and upgrading train for RNG production. A few hours of storage may be provided in a pad mounted membrane gas buffer. An emergency flare is provided in the event that the biogas utilization system is unavailable due to maintenance or malfunction and the produced gas is safely flared off.
- **Odor Treatment:** Odorous air is typically not treated as it is assumed that sensitive receptors are at adequate distance to the Dairy and digester installation.

Typical design and performance parameters (for unheated and unmixed) covered lagoon digesters are as follows:

- Total solids of digester feed: < 2%

² Per PG&E Gas Rule No. 21

- Volatile solids of digester feed: 70 – 85%
- Hydraulic retention time (HRT): 55 days
- Organic loading rate target: 10 pounds of VS per thousand cubic feet and day
- Specific biogas yield per VS input: 6 – 8 cubic feet per pound of VS fed to digester
- Average Specific biogas yield per VS excretion: 3.5 cubic feet of biogas per pound of manure VS excretion
- Specific biogas yield per VS consumed: 14 – 18 cubic feet per pound of VS consumed

4.2.2 Biogas Cleaning

Digester gas quality produced by manure digesters is similar regardless of the type of manure collection. As noted above, a scraped system is a good fit for a plug flow digester and lagoons may be appropriate for a covered lagoon system. However, data suggest the plug flow digester may produce more digester gas per pound of manure input owing to mixing and heating of the digester. Digester gas is composed of methane, carbon dioxide, nitrogen, oxygen and water vapor. Only methane has energy value. Contaminants such as hydrogen sulfide and volatile organic compounds (VOCs) may interfere with end uses and need to be removed from the gas stream. Raw digester gas also may contain particulates that can be trapped or filtered out of the gas stream.

The biogas cleaning system will upgrade the digester gas to RNG by separating methane from the digester gas and treat the gas to meet applicable pipeline or vehicle fuel standards. Nitrogen and oxygen occur in digester gas due to air intrusion and are not readily separated from methane. The effect of nitrogen and oxygen is to dilute the fuel value of the RNG. Ensuring a tightly sealed digester will reduced air intrusion and improve the energy content of the RNG product.

Since dairy manure is known to have significant concentrations of hydrogen sulfide (H₂S), the removal of sulfur is an essential element of the gas treatment requirements. The first step in gas treatment train may be H₂S removal as many adsorbents or biological systems require moist gas. The next step would be moisture removal to prevent condensation in the piping system. Moisture removal is accomplished by chilling the gas to a 40°F dewpoint to condense moisture and the reheat to 80°F to create separation from dewpoint. Siloxanes and VOCs are not typically found in digester gas from dairy manure so additional contaminant removal is not indicated.

The next step is separating the carbon dioxide from the methane, which is the key upgrading step. Several technologies to be considered for CO₂ removal are depicted in Table 4-4.

Table 4-4 Comparison of Characteristics of CO₂ Removal Technologies

TECHNOLOGY	METHANE CONTENT IN RNG (%)	METHANE LOSS (%)	REQUIRES WASTE GAS TREATMENT ⁽¹⁾	ELECTRICAL DEMAND (KW/SCFM)	WATER CONSUMPTION (GAL/1000 SCF)
PSA	98 to 99	1 to 2	Yes	0.45	0
Membrane (3-pass)	> 97	<1	No	0.48	0
Water Scrubbing	97 to 98	2 to 3	Yes	0.45	2
Amine Scrubbing	> 99	0.1	No	0.18 ⁽²⁾	0.3

Notes:

- (1) If the waste gas stream contains some quantity of methane in addition to CO₂, the waste gas must be sent to a thermal oxidizer or otherwise combusted prior to release to the atmosphere.
- (2) Amine scrubbing require heat input as well not reflected in electrical demand

The Wobbe index for the RNG with 97 percent or greater methane and 1% or less CO₂ will be approximately 1,300 BTU/SCF. This energy density is suitable for pipeline injection and vehicle fuel use, so propane blending is not anticipated.

5.0 Civil/Structural Design Basis

5.1 ENVIRONMENTAL CRITERIA

Load calculations are based on ASCE 7-10.

5.1.1 Rainfall

- 100-Year, 1-Hour Rainfall: 1 inch
- 100-Year, 12-Hour Rainfall: 3 ½ inches
- 100-Year, 24-Hour Rainfall: 4 inches
- Maximum recorded in 24 hours (25-year frequency): 3 ½ inches

5.1.2 Wind

- Basic Wind Speed, mph: 115
- Exposure Category: C
- Topographic Factor, Kzt: 1.0

5.1.3 Seismic

- Short Period Mapped Spectral Acceleration, S_s: 1.088
- One Second Period Mapped Spectral Acceleration, S₁: 0.378
- Site Class: C
- Importance Factor (Seismic Loads), I_e: 1.25

5.1.4 Snow

- Ground Snow Load, P_g, lb/ft²: 0
- Importance Factor (Snow Loads), I_s: 1.10

5.2 DESIGN CRITERIA

5.2.1 Design Loads

Design loads and load combinations for all buildings, structures, structural elements and components, handrails, guardrails, and connections shall be determined according to the criteria specified in this section (refer to Table 5-1). Loads imposed on structural systems from the weight of all temporary and permanent construction, occupants and their possessions, environmental effects, differential settlement, and restrained dimensional changes shall be considered.

The live loads used in the design of buildings and structures shall be the maximum loads likely to be imposed by the intended use or occupancy but will not be less than the minimum uniform live loads presented in Table 5-2. Components of the structural system may be designed for a reduced live load in accordance with the local building code. Roofs shall be designed to preclude instability resulting from ponding effects by ensuring adequate primary and secondary drainage systems, slope, and member stiffness. Structural elements supporting equipment shall be designed for the greater of the uniform live load or the loading imposed by the actual equipment.

Buildings and Other Structures

Process buildings shall have vertical bracing positioned to maintain a regular structure classification. Rigid structures, such as turbine equipment support structures, shall be isolated

from the turbine building structure so that each provides its own discrete lateral force resisting system, unless coordinated and calculated to meet the regular structure classification.

All buildings shall have bracing located so as to minimize internal restraint to dimensional changes. Component supports and anchorages shall be configured so as to be rigid.

Table 5-1 Design Loads

Load Types	Criteria/Source
Dead Loads	ASCE 7-10, Tables C3-1 and C3-2.
Pipe Support, major piping (Major piping is defined as hot pipe greater than or equal to 2-1/2 inches [65 mm] in diameter and cold pipe greater than or equal to 24 inches [610 mm] in diameter.)	Specifically determined, including thermal and dynamic loads, and verified against final pipe routing and analysis.
Pipe Support, other piping and electrical conduit and cable tray	Preliminary design for uniform area, line, and/or concentrated loads located to create contingency moments and shears.
Live Loads	Calculated weight of the contents of tanks; movable loads, such as people, equipment, tools, and components during construction, operations, and maintenance; maximum loads likely to be imposed by intended use or occupancy, but not less than the loads in Table 5-2, nor actual equipment weight.
Impact Loads	Table 5-2 loads allow for ordinary impact conditions. Reciprocating or rotating machinery, elevators, cranes, pumps, and compressors shall have specific calculations addressing dynamic forces. Impact loads shall be as specified in ASCE 7 Chapter 4 unless analysis indicates higher values are required.
Soil and Hydrostatic Loads	Below grade structures shall include static and seismic lateral soil pressure, expansive soil pressures, hydrostatic pressure or buoyancy, compaction energy pressure, and potential surcharge loads from normal service or construction.
Wind Loads, buildings and structures	Basic design wind speed shall be in accordance with ASCE 7, Subsection 1.7.2. No shielding shall be permitted for ground conditions or for adjacent structural members.
Wind Loads, steel stacks	Loads and design in accordance with ASME STS-1.
Snow Load	Minimum ground snow load shall be in accordance with ASCE 7, Subsection 1.7.2. Drift loads shall be applied to roof discontinuities and roof regions shielded by large roof-mounted equipment or machine penthouses.
Ice Loads	Applicable to steel lattice type structures and guy cables. Ice accretion shall be in accordance with ASCE 7, Subsection 1.7.2. An ice density of 57 lb/ft ³ (915 kg/m ³) shall be used.
Seismic Loads, buildings (by building, if appropriate)	Refer to ASCE 7, Subsection 1.7.2.
Seismic Loads, components and attachments	Amplification and response modification factors in accordance with ASCE 7.

Load Types	Criteria/Source
Construction Loads, roads	AASHTO HS 20 or equivalent.
Fatigue Loads	In accordance with AISC Specification for Structural Steel Buildings.
Personnel Load	
Fixed Metal Ladders	One 300 pound load for every 10 feet of ladder height or two 300 pound concentrated loads between any two consecutive attachments, whichever is greater. Rungs are designed for a single concentrated load of 300 pounds.
Stairs	1,000 pound concentrated load applied at any point. Non-concurrent with 100 psf live load in Table 5-2.

Table 5-2 Minimum Uniform Live Loads

Area	Live Load, psf (kN/m ²)
Ground Floor Slabs	
Boiler area	150 (7.2)
Turbine area	150 (7.2)
Shops, warehouses	125 (6.0)
Other structures	100 (4.8)
Suspended Floors	
Turbine operating floor	Weight of major components, but not less than 250 (12.0)
Control Room	100 (4.8)
Storage Areas	Weight of stored material, but not less than 125 (6.0)
Other Concrete Floors	100 (4.8)
Grating Floors	60 (2.9)
Roofs	20 (1.0)
Stairs	100 (4.8)
Cooling Tower Decks	60 (2.9)

Construction Loads

Construction or crane access considerations may dictate the use of temporary structural systems. Special considerations will be made to ensure the stability and integrity of the structures during any periods involving use of temporary bracing systems.

Wheel Loads

Wheel loads will be considered for roadway pavements, bridges, buried piping, culverts, and embankments. Roadway subgrades, pavements, and structures shall be designed for HS20 or equivalent load.

5.2.2 Architecture

Exterior Architecture Criteria

The exterior architectural systems provide a durable, weathertight enclosure to protect systems and personnel and allow for a controlled interior environment. Exterior architectural systems shall conform to the general design criteria in Table 5-3 for main plant buildings and principal yard buildings.

Interior Architecture Criteria

The interior architectural systems provide a functional, low maintenance, aesthetically pleasing environment. The materials in Table 5-4 have been selected to provide durability and offer flexibility in responding to occupant demands, while satisfying project and code requirements. Interior architectural systems shall conform to the general design criteria in Table 5-4 for main plant buildings and principal yard buildings.

Egress Criteria

Equipment platforms are considered unoccupied spaces as defined by IBC and access to them will be as required by NFPA 101 Chapter 40. Following is a list of equipment platforms that will follow the Chapter 40 requirements:

- Process unit stair towers that service open structures and platforms.
- Tanks.
- Cooling towers.
- Utility racks.

Table 5-3 Exterior Architecture Criteria

Item	Criteria
Walls	May consist of insulated or uninsulated metal wall panel. Building enclosures may also be preengineered.
Roofs	May consist of an insulated metal standing seam panel system or single-ply membrane over insulation and a metal roof deck.
Masonry	May consist of concrete block, which may be utilized for enclosure and separation purposes.
Thermal Insulation	Shall have insulation incorporated into the walls and roofs for thermal design and meet energy codes.
Acoustical Insulation	Shall have insulation incorporated into the walls and roofs for acoustical design.
Louvers	Shall include vertical storm louvers as required by the ventilation design.
Windows	May include windows, frames, and glazing. Selection shall be based on project and environmental requirements.

Item	Criteria
Personnel Doors	Shall include hollow, metal type personnel doors. Insulation and fire rating criteria shall be dictated by the interior and environmental requirements.
Equipment Access Doors	Shall include large exterior doors of the rolling metal type, with weather seals and windlocks.
Finish Painting	Exterior steel materials not galvanized or factory finished shall be field painted. Colors shall be selected and will harmonize with the project color scheme.

Table 5-4 Interior Architecture Criteria

Item	Criteria
Partitions	Partitions constructed of masonry, drywall, or metal wall panel.
Windows	Interior fixed windows as required by the occupancy. Rated and nonrated glazing shall be installed in accordance with fire and building code criteria.
Personnel Doors	Hollow, metal type personnel doors. Insulation and fire rating criteria shall be dictated by the interior and environmental requirements.
Ceilings	Ceilings in finished areas of the main buildings and principal yard buildings shall generally consist of suspended, exposed grid, lay-in acoustical type systems. Wet areas shall consist of moisture resistant materials.
Floor Coverings	Floor coverings in finished areas shall generally consist of resilient tiles or carpet tiles. Floor coverings in control and electrical equipment rooms may be static dissipative. High moisture areas shall incorporate unglazed ceramic tiles.
Wall Coverings	Glazed wall tiles shall be used in shower and toilet rooms as required for maintenance and sanitary requirements. All other finished area walls shall be coated as identified in the painting section.
Finish Painting	Interior areas shall be coated where required for chemical resistance, light reflection, or aesthetics.
Sanitary Facilities	Toilet and shower facilities and associated accessories shall be provided where required to meet code and project requirements.

In open structures, such as process units and cooling towers, plant scheduled routine maintenance shall be achieved with three or less occupants. Egress for plant scheduled routine maintenance is accomplished with a common path of travel of 200 feet and/or a ladder used as a second means of egress. Occupancy limits of the structure shall be achieved through signage and Owner administrative controls.

5.2.3 Concrete

Reinforced concrete structures shall be designed in accordance with ACI 318, Building Code Requirements for Structural Concrete, and the design parameters in Table 5-5, Table 5-6, and Table 5-7.

Mix Design

Mix design shall be in accordance with Table 5-5. A larger coarse aggregate size may be considered for mass concrete. Grout is “sand-only” mix.

Table 5-5 Mix Design

Mix Class	Maximum Exposure Classes *	Usage	Design Strength at 28 Days, psi (kPa)	Cement Type	Maximum Water/Cementitious Materials Ratio	Air Content, percent	Maximum Coarse Aggregate Size, in. (mm)	Max Slump, in. (mm)
A1	NA	Lean work slabs, duct bank, fill concrete	2,000	I, II, or V	0.75	0	1.5 (38)	6 (150)
B1	F0 S0 P1 C1	General usage – no freeze/thaw	4,000	I, II, or V	0.50	3-6	1 (25)	4 (100)
B2	F2 S0 P1 C1	General usage – with freeze/thaw	4,500	I, II, or V	0.45	6	1 (25)	4 (100)
C1	F2 S1 P1 C1	Structure in contact with water or exposed to moderate sulfate exposure	4,500	I (C ₃ A<5%), II, or III (C ₃ A<8%),	0.45	6	1 (25)	4 (100)
C2	F2 S2 P1 C1	Structure in contact with water or exposed to severe sulfate exposure	4,500	I (C ₃ A<5%), III (C ₃ A<8%), or V	0.42	6	1 (25)	4 (100)
D1	F0 S0 P1 C1	Foundation piers and cased reinforced concrete piling – no freeze/thaw	4,500	I, II, or V	0.50	0	0.75 (20)	4 (100)

Mix Class	Maximum Exposure Classes *	Usage	Design Strength at 28 Days, psi (kPa)	Cement Type	Maximum Water/Cementitious Materials Ratio	Air Content, percent	Maximum Coarse Aggregate Size, in. (mm)	Max Slump, in. (mm)
D2	F2 S0 P1 C1	Foundation piers and cased reinforced concrete piling – with freeze/thaw	4,500	I, II, or V	0.45	6	0.75 (20)	4 (100)
E1	F0 S0 P1 C1	Underwater concrete	4,000	I, II, or V	0.45	3-6	1 (25)	6-9 (150-225)
F1	F2 S2 P1 C1	Sulfur pits	4,500	V (C ₃ A<6%)	0.40	6	0.75 (20)	3 (75)

* Refer to Chapter 4 of ACI 318 for exposure classes.

Materials Usage

Table 5-6 Materials Usage Requirements

Material	Usage	Requirements
Cement	In accordance with Mix Design, local supply	ASTM C150/C150M.
Water	In accordance with Mix Design, local supply	Potable.
Aggregate	In accordance with Mix Design, local supply	ASTM C33/C33M.
Reinforcing Steel, main	In accordance with detail design requirements	ASTM A615/A615M, Grade 60.
Reinforcing Steel, ties and stirrups	In accordance with detail design requirements. Typically, No. 4 (D13)	ASTM A615/A615M, Grade 60.
Forms	All exposed concrete surfaces (not flatwork)	Plywood or modular steel, dimensions to nearest inch.

Materials Application

Table 5-7 Materials Application Criteria

Member	Criteria
Suspended Slabs	Two-way reinforced; 3/4 inch (20 mm) minimum cover; 6 inch (150 mm) minimum thickness; steel trowel finish; spray with curing compound.
Structural Beams	Singly reinforced; 3/4 inch (20 mm) minimum cover interior, 1-1/2 inch (40 mm) cover exterior; beam width in 2 inch (50 mm) increments, minimum 8 inches (200 mm); beam depth in 2 inch (50 mm) increments, minimum 12 inches (300 mm); cured 3 days in forms.
Grade Beams	Singly reinforced; 1-1/2 inch (40 mm) cover; beam width in accordance with excavator requirements, minimum 8 inches (200 mm); void forms between pier supports, 4 inch (100 mm) minimum thickness.
Spread Footings	6 inch (150 mm) dimension increments for footing dimensions less than 9 feet (2,740 mm); 3 inch (75 mm) bottom cover on soil; 1-1/2 inch (40 mm) bottom cover on mudmat.
Special Massive Machine Foundations	1-1/2 inch (40 mm) cover; dimensions to nearest 2 inches (50 mm), unless specifically for machine interface as required; reinforced for surface crack control.

5.2.4 Steel Structures

Steel framed structures shall be designed in accordance with the AISC Specification for Structural Steel Buildings. In addition, steel framed structures shall be designed in accordance with the criteria discussed in the following subsections.

Materials

Construction of steel structures shall use materials as defined in Table 5-8.

Table 5-8 Structural Steel Materials

Material	Criteria
Structural steel wide flange and WT shapes	ASTM A992/A992M.
Structural steel channels	ASTM A992/A992M; ASTM A572/A572M, Grade 50; ASTM A36/A36M.
Structural steel S shapes	ASTM A36/A36M; ASTM A992/A992M; ASTM A572/A572M, Grade 50.
Structural steel angles and plates	ASTM A572/A572M, Grade 50; ASTM A529/A529M, Grade 50; ASTM A36/A36M.
Structural steel baseplates and plate over 4 inches thick	ASTM A36/A36M.
Hollow structural shapes, round, rectangular or square	ASTM A500/A500M, Grade C.
High Strength Bolts	<p>ASTM A325, 3/4 inch, 7/8 inch, or 1 inch diameter, 1/4 inch increments of length, 1/4 inch increments on bolt diameter when different bolt sizes are used, fully-tensioned bearing type designed with threads included in the shear plane for all connections except where slip-critical connections are required. Connections with oversized holes or slots in the direction of load are slip critical.</p> <p>ASTM A325M, M20, M22, or M24, 5 mm increments of length, 4 mm increments on bolt diameter when different bolt sizes are used, fully-tensioned bearing type designed with threads included in the shear plane for all connections except where slip-critical connections are required. Connections with oversized holes or slots in the direction of load are slip critical.</p>
Weld Filler Metal	70 ksi (485 MPa) tensile strength.
Atmospheric Corrosion-Resistant Steel	ASTM A588/A588M.
Extreme Corrosion-Resistant Stainless Steel	ASTM A167, type as required.
Guardrail and Handrail	Steel pipe 1-1/2 inch (38 mm) diameter, ASTM A53/A53M, Type E or S, Grade B; HSS 1.9 inch (48 mm) diameter, ASTM A500, Grade C; Guardrail only - Steel angles 2-1/2 x 2-1/2 x 1/4 inch (64 x 64 x 6.4 mm).
Kickplate (Toeplate)	Fabricated from ASTM A36/A36M plate 4 inches x 1/4 inch (100 mm x 6 mm).

Material	Criteria
Steel Grating	3/16 inch by 1-1/4 inch (5 mm by 32 mm) bearing bars, galvanized.
Anchor Rods, sized for design loads	ASTM F1554, Grade 36, 1/2 inch (13 mm) increments of diameter.
Anchor Rods, sized for design loads and pretensioned	ASTM F1554, Grade 105, 1/2 inch (13 mm) increments of diameter.
Stair Treads	Steel grating, cast abrasive or bent checker plate nosings.
Metal Deck, roof	1-1/2 inch (38 mm) profile depth, 22 gauge minimum, galvanized.
Metal Deck, form	1 inch (25 mm) profile depth, 24 gauge minimum, painted or galvanized (composite deck form only).
Ladders	Fabricated from ASTM A36/A36M bar rails 3 inches x 1/2 inch (75 mm x 13 mm) with 3/4 inch (19 mm) diameter rungs.

Design

Construction of steel structures shall use design practices defined by local building codes, but not less than those defined in Table 5-9.

Table 5-9 Structural Steel Design

System	Criteria
Lateral Building Drift, rigid frame structures	(Story or building height)/100 under wind, ASCE 7 for seismic.
Lateral Building Drift, braced frame structures	(Story or building height)/200 under wind, ASCE 7 for seismic.
Vertical Bracing Members	Designed and detailed for concentric loading, unless analyzed for work point and shape eccentricity. Compression and tension capable, “pinned” at all connection points.
Horizontal Bracing Members	Designed and detailed for concentric work point loading and eccentric shape loading. Compression and tension capable, “pinned” at all connection points.

System	Criteria
<p>Beams - Lateral-Torsional Buckling Brace Points</p>	<p>The following shall be considered as points of lateral-torsional stability bracing for beams:</p> <ul style="list-style-type: none"> • Roof deck connections, $L_b = 3$ times deck fastener spacing • Floor deck connections, $L_b =$ Lesser of 3 times deck fastener spacing or the actual shear connector spacing • Floor grating, welded connections--Use 1-inch (25 mm) fillet welds at 12-inch (300 mm) spacing (min.), add drawing notes to caution against removing grating, $L_b =$ weld spacing • Horizontal truss panel point incident beams-- Incident beam top of steel offset 3 inches (75 mm) or $(1/6)$ (braced beam depth), maximum • Incident beams axially aligned with horizontal truss panel points--Incident beam top of steel offset 3 inches (75 mm) or $(1/6)$ (braced beam depth), maximum • Incident beams connected to H-brace stability connections--Incident beam top of steel offset 3 inches (75 mm) or $(1/6)$ (braced beam depth), maximum • Incident beams connected to floor slabs or roof truss diaphragms--Incident beam top of steel offset 3 inches (75 mm) or $(1/6)$ (braced beam depth), maximum • Incident beams connecting three or more parallel beams, parallel beams have 20 percent or less difference in weight--Incident beam top of steel offset 3 inches (75 mm) or $(1/6)$ (braced beam depth), maximum • Incident beams connecting two parallel beams-- Verified by calculation only

System	Criteria
Columns - Lateral-Torsional Buckling Brace Points	<p>The following shall be considered as points of lateral-torsional stability bracing for columns:</p> <ul style="list-style-type: none"> • Incident beams connected to the space truss--Note for standard column sizes (W14 [W360] and smaller), incident beams connecting to the center of the column web restrain the column flanges against lateral buckling. For deep columns (W16 [W410] and larger), the incident beams may require special connections to restrain the column compression flange(s) against lateral movement. • Incident beams connecting three or more adjacent columns--Note for standard column sizes (W14 [W360] and smaller), incident beams connecting to the center of the column web restrain the column flanges against lateral buckling. For deep columns (W16 [W410] and larger), the incident beams may require special connections to restrain the column compression flange(s) against lateral movement. • Girts with flange braces
Beams - Major Axis Compression Buckling Brace Points	<p>The major axis compression buckling points for beams shall occur only at the beam supports. Major axis unbraced length for beams, L_x, shall equal the beam span.</p>
Beams - Minor Axis Compression Buckling Brace Points	<p>The following shall be considered as points of weak-axis compression-buckling stability bracing for beams:</p> <ul style="list-style-type: none"> • Horizontal truss panel points with or without incident beams • Incident beams axially aligned with horizontal truss panel points • Incident beams connected to floor slabs or roof truss diaphragms
Columns - Major and Minor Axis Compression Buckling Brace Points	<p>The following shall be considered as points of compression-buckling stability bracing for columns:</p> <ul style="list-style-type: none"> • Incident beams connected to the space truss • Incident beams connecting two adjacent columns-- Verified by calculation only
Vertical Braces - Compression Buckling Brace Points	<p>The following shall be considered as brace points for vertical bracing:</p> <ul style="list-style-type: none"> • Buckling in the plane of the truss--“X-bracing” or single side strut • Buckling out of the plane of the truss--“X-bracing”
Unbraced Length, pipe bracing in ducts	<p>$KL/r \leq 120$, checked for vortex shedding in flow and thermal restraint forces.</p>
Deflection, floors and roofs, live load only	<p>Span/360, vertical, unless attached to more rigid, brittle members.</p>
Deflection, floors and roofs, dead and live load combined	<p>Span/240, vertical.</p>

System	Criteria
Deflection, girts	Span/180, horizontal. Span/240, vertical. When over or under glass, Span/360, horizontal. Span/960, vertical.
Deflection, crane and hoist support beams (without "impact")	Span/600, vertical; span/400, lateral.
Fixed ladder fall prevention (for OSHA compliant projects)	Ladders with the top rung more than 24 feet above a lower level will be provided with a fall prevention device. Ladders 24 feet or less above a lower level are not required to have fall protection.

5.2.5 Site

Grading and Drainage

Site grading and drainage shall be designed to comply with all applicable federal, state, and local regulations, and shall be integrated with existing site drainage systems so far as possible.

Roads

Road design component criteria are defined in Table 5-10.

Fencing and Security

The perimeter fence around the site boundary shall be woven wire. The perimeter fencing system shall include normally locked swing gates for access. The fence fabric shall be placed on the opposite side of the secure side of the fence.

Table 5-10 Site Design Component Criteria

Design Component	Criteria
Grading Slope, minimum	0.5 percent in main plant complex, or as appropriate for surface type, conveying storm runoff away from permanent facilities.
Roadway Linear Slope, maximum	8 percent unless Owner approves a steeper slope.
Finish Floor Relative Elevation	6 to 12 inches (150 to 300 mm) above 1 percent probability (100 year) storm event.
Culverts	Reinforced concrete, corrugated metal, or corrugated high density polyethylene (HDPE) pipes; reinforced concrete box where necessary.
Drainage Facilities and Water/Wastewater Storage Pond Storm Event, unless local code or regulations control	25-year, 24-hour rainfall event
Roads, main plant access	Two 10-foot (3.0 m) asphalt paved lanes, optional 3-foot (0.9 m) aggregate surfaced shoulders.
Roads, other than main plant access	Two 10-foot (3.0 m) aggregate surfaced lanes, no shoulders.

5.2.6 Foundations

General Criteria

Foundations shall be designed using reinforced concrete to resist the loading imposed by the building, structure, tanks, or equipment being supported. The foundation design shall consider the following:

- Soil bearing capacities.
- Deep foundation capacities.
- Lateral earth pressures.
- Allowable settlements, including differential settlements.
- Structure, equipment, and environmental loadings.
- Equipment performance criteria.
- Access and maintenance.
- Temporary construction loading.
- Existing foundations and underground structures including their current settlement conditions.

Foundations shall be designed using static analysis techniques assuming rigid elements and linear soil pressure distribution so that the allowable settlement and bearing pressure criteria are not exceeded. Foundations shall be proportioned so that the resultant of the soil pressure coincides as nearly as possible with the resultant of the vertical loading. The minimum factors of safety against overturning and sliding shall be 1.5. Factor of safety against sliding for retaining walls shall also be 1.5.

When using ASCE 7 load combinations that apply a 0.6 factor on dead load, the factor of safety for overturning and sliding is automatically set at approximately 1.67. For these special ASCE 7 ASD load combinations, the ratio of resisting forces (0.6 dead load) over driving forces (wind, seismic, or lateral loads) should be greater than 1.0 instead of 1.5.

Geotechnical exploration, testing, and analysis information shall be used to determine the most suitable foundation system. Elastic (short-term) and consolidation (long-term) foundation settlements shall be calculated and limited to the following approximate design values except where loading onto or differential settlements relative to existing structures may require more conservative criteria:

- Total settlement: 1-1/2 inches (38 mm).
- Differential settlement: 0.1 percent slope between adjacent column support points.

Allowable settlement is higher for tanks. These settlements will be calculated on an individual basis.

Special Foundation Requirements for Chimneys and Stacks

The foundation component for the chimneys and stacks shall be a circular or polygon shaped pier, pile, or ground supported, reinforced concrete foundation. The foundation shall be proportioned so that the bearing and allowable settlement criteria shall not be exceeded, with no uplift permitted and no increase in allowable bearing for wind load for soil supported foundations. For pile supported foundations, uplift on piles is allowed. Design settlement, elastic plus consolidation, shall be limited to approximately 1-1/2 inches (38 mm) for soil supported foundations.

Special Foundation Requirements for Rotating Equipment

The foundation systems for major rotating equipment shall be sized and proportioned so as not to exceed the bearing and settlement criteria, and to ensure satisfactory performance of the equipment. In addition to a static analysis, a dynamic analysis may be performed to determine the fundamental frequencies of the foundation system for selected major rotating equipment as determined necessary by Black & Veatch. To preclude resonance, fundamental frequencies of the foundation associated with rigid body motion shall be 25 percent removed from the operational frequency of the equipment. Should the foundation system not meet these criteria, a balance quality grade, appropriate for the equipment, will be determined from ISO 1940, Balance Quality Requirements of Rigid Rotors - Part 1. The dynamic behavior of the foundation will be evaluated for this level of unbalance and compared to ISO 10816, Mechanical Vibration-Evaluation of Machine Vibration by Measurements on Nonrotating Parts, Parts 1 through 6. The resultant vibration level shall not exceed the limit for evaluation of this standard. Where required, the foundation shall also be designed to meet manufacturer's requirements.

Foundation Design Criteria

Foundations to be designed per the geotechnical report to be provided by Trinkler Dairy.

Equipment Bases

All equipment shall be supplied with an equipment base suitable for its operation. Where the equipment could induce vibration problems, the base shall have adequate mass to dampen vibration motions. Special consideration shall be given to vibration and stiffness criteria where specified by an equipment manufacturer.

Equipment bases may be concrete or an integral metal skid. Concrete bases shall have minimum temperature and shrinkage reinforcing; unless it is determined that additional reinforcement is required for the equipment loads.

Insulation

When required by the local code, foundations and below grade portions of space-conditioned buildings above those foundations shall be insulated.

6.0 Mechanical Design Basis

6.1 DESIGN CRITERIA

6.1.1 Piping, Components, and Accessories

The requirements for piping, components, and accessories are shown in Table 6-1 by system/process.

Table 6-1 Piping, Components, and Accessories Requirements

Fluid Code	Power System Code	System/ Process Area	Flange Rating (B16.5)	Pipe Material	Special Requirements	Post-Weld Heat Treatment (PWHT)	Notes
GF	FGA	Fuel Gas	1500	CS 304	Fire safe		G01
	DGG	Digester Gas	150	304 PVC			G01 201, 202, 204
WW	WWC	Waste Water	150	FRP-Epoxy			G01
WW	WWC	Waste Water (U/G)	200 psi 150	HDPE DI	Cement-Mortar lined		G01, 501, 505, 603
AI	CAB	Instrument Air	150	304			G01
GN2	PMB	Nitrogen	150	CS			G01, G04, G08, 902
GC02	CGB	Carbon Dioxide	300	CS		B31.1	G01
WU	WSA	Utility Water	150	CS			G01, G04, G08, 902
WU	WSA	Utility Water (U/G)	200 psi	HDPE 4710			G01, 501, 505
FPW	STG, WSE	Fire Protection	150	CS	UL/FM Approved - VICTAULIC		G01, 702, 902
WF	STG	Fire Protection (U/G)	200 psi	HDPE 4710	31PFNF: UL/FM Approved/11PFNF: AHJ to be consulted for fire water application		G01, 501, 503, *Allowable Stresses for PE4710 pending approval of the AHJ.

Notes:
 G01 – Addition or substitution of components (material A vs. material B, welded vs. seamless, etc.) in this piping class requires approval from the piping engineer.
 G04 - Threaded components are permitted only at outlet of vent, drain, and instrument valves and to match equipment.
 G08 - Component wall thickness and end preparation type to be the same as the pipe.
 201 - Materials in contact with the piped fluid, including solvent cement, shall be suitable for continuous service with aqueous solutions containing up to 12.5% sodium hypochlorite.

Fluid Code	Power System Code	System/ Process Area	Flange Rating (B16.5)	Pipe Material	Special Requirements	Post-Weld Heat Treatment (PWHT)	Notes
202 - PVC & CPVC pipe and fitting joints shall be made in accordance with the Manufacturer’s recommendations using solvent cement as specified by ASTM F493. 204 - Non-standard size reducing tees may be produced by solvent cementing reducing bushings with socket tees or reducing socket tees, utilizing the minimum standard components. 501 - Pipe and fittings to be manufactured to iron pipe size (IPS) dimensions. Pipe, fittings, and branches shall be joined per ASTM F2620, “Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings” and the “PPI Handbook of Polyethylene Pipe Joining Procedures.” 503 - HDPE pipe, fittings, flanges, and gaskets in fire protection water service shall be FM Approved for Fire Protection use. 505 - Pipe, fittings, and branches shall be joined in accordance with ASTM D2657, “Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings”, and the “PPI Handbook of Polyolefin Pipe Joining Procedures”. 603 – Minimum Type “3” laying conditions require (ANSI/AWWA C151/A21.51) 702 - Pipe, fittings, flanges, gaskets, and valves shall be UL Listed or FM Approved for fire water service. 902 - A106-B pipe is an acceptable substitute for A53-B pipe. As applicable, seamless fittings are acceptable substitutes for welded fittings.							

6.1.2 Valves

The valve selection criteria are shown in Table 6-2 by system/process and the short-hand acronyms and type classifiers used in this table are identified in the associated legend present in Table 6-3.

Table 6-2 Valve Selection Criteria

	Isolation				Throttling				Vent		Drain	
	≤ 2”		≥ 2.5”		≤ 2”		≥ 2.5”		Type	End	Type	End
	Type	End	Type	End	Type	End	Type	End				
Fuel Gas Supply	B P	SW	B P	BW FLG	T F B	SW FLG	T F	BW FLG	B P	SW	B P	SW
Digester Gas	B	SW	B F	FLG	NA	NA	NA	NA	B	SCRD	B	SCRD
Waste Water	B G	SW FLG	G F	FLG WFR	T	SW SCRD FLG	F T	WFR FLG BW	B G T	SW FLG	B G	SCRD SW FLG
Waste Water (U/G)	B G	SW FLG	G F	FLG WFR	T	SW SCRD FLG	F T	WFR FLG BW	B G T	SW FLG	B G	SCRD SW FLG

	Isolation				Throttling				Vent		Drain	
	≤ 2"		≥ 2.5"		≤ 2"		≥ 2.5"		Type	End	Type	End
	Type	End	Type	End	Type	End	Type	End				
Compressed (Station) Air	B	P-FIT	G	BW FLG	T	P-FIT FLG	T F	BW FLG	B	P-FIT SCRDBR	B	P-FIT SCRDBR
Instrument Air	B	P-FIT	G	BW FLG	T	P-FIT FLG	T F	BW FLG	B	P-FIT SCRDBR	B	P-FIT SCRDBR
Nitrogen	B	P-FIT SCRDBR	G	BW FLG	T	P-FIT SCRDBR	T F	BW FLG	B	P-FIT SCRDBR	B	P-FIT SCRDBR
Carbon Dioxide	B	P-FIT SCRDBR	G	BW FLG	T	P-FIT SCRDBR	T F	BW FLG	B	P-FIT SCRDBR	B	P-FIT SCRDBR
Service Water	BGT	P-FIT SW	FG	WFR FLG	T	P-FIT SCRDBR SW	FT	WFR FLGBW	BGT	P-FIT SCRDBR SW	BGT	P-FIT SCRDBR SW
Fire Protection Water	G	SCRDBR	G	FLG	T	SCRDBR	T	BW FLG	G	SCRDBR	G	SCRDBR
Fire Protection Water (U/G)	G	SCRDBR	G	FLG	T	SCRDBR	T	BW FLG	G	SCRDBR	G	SCRDBR

Table 6-3 Legend for Table 6-2

Type		Ends	
B	Ball	WFR	Wafer or Lug Wafer
G	Gate	FLG	Flanged
T	Globe	BW	Butt Welded
Y	Y-Pattern Globe	SW	Socket Welded
P	Plug	SCRDBR	Threaded
F	Butterfly	P-FIT	Victaulic Press Fit
NA	Not Applicable	BR	Brazed

6.1.3 Coatings

External Coatings

External coatings are described in Table 6-4 by equipment type and design temperature.

Table 6-4 External Coating Descriptions

Section	Description	Design Temp (°F)	Coating System
1.0	Pipe and Pipe Supports		
1.1	Carbon Steel		
1.1.1	Uninsulated	≤200	Epoxy (EPS)/ Epoxy (EPS)/ Polyurethane (URA)
1.1.2		>200 ≤1,000	Inorganic Zinc (IZ)/ Silicone Acrylic (SLA)
1.1.3	Insulated	>25 <350	Epoxy Phenolic (EPP)/ Epoxy Phenolic (EPP)
1.1.4		>300 (>149)	Alkyd (ALK) ^[NOTE 1]
1.2	Stainless Steel		
1.2.1	Uninsulated	All	No coating
1.2.2	Insulated	>120 <350	Epoxy Phenolic (EPP)/ Epoxy Phenolic (EPP) ^[NOTE 2]
1.2.3		>350 <120	No coating
2.0	Tanks, Drums, Columns, Vessels, Reactors, and Shell and Tube Heat Exchangers - Shop Fabricated		
2.1	Carbon Steel		
2.1.1	Uninsulated	≤200	Epoxy Zinc (EPZ)/ Epoxy (EPS)/ Polyurethane (URA)
2.1.2		>200 ≤1,000	Inorganic Zinc (IZ)/ Silicone Acrylic (SLA)
2.1.3	Insulated	>25 <350	Epoxy Phenolic (EPP)/ Epoxy Phenolic (EPP)
2.1.4		>350	Alkyd (ALK) ^[NOTE 1]
2.2	Stainless Steel		
2.2.1	Uninsulated	All	No Coating
2.2.2	Insulated	>120 <350	Epoxy Phenolic (EPP)/Epoxy Phenolic (EPP) ^[NOTE 2]
2.2.3		>350 <120	No Coating
3.0	Bulk Valves, Fittings, Pumps, Compressors, Rotating Equipment, and Other Mechanical Equipment Not Specified Otherwise	All	Q301 Manufacturer’s Standard Coating for the intended ISO 12944 C4 environment.

Notes:

1. Alkyd (ALK) coating is provided for short-term corrosion protection during shipping, storage, and construction. No coating is required if the time interval between shipment and startup is less than 24 months.
2. Applicable to 18-8 austenitic stainless steels, e.g., 304 and 316, and duplex stainless steels. Coating is not required for higher alloyed materials.

Internal Coatings

Internal coatings and cleaning requirements are described in Table 6-5 by system/process type.

Table 6-5 Internal Coatings and Cleaning Methods

System Name	Piping Fabrication Cleaning Method ⁽¹⁾	Post-Fabrication Preservative or Coating Option ⁽²⁾	Post-Installation Cleaning ^(3,4,5)
Fuel Gas	SP6 – Commercial Blast Cleaning	1001- Vapor phase corrosion inhibitor (water soluble preservative)	Pigging (below grade) Air Blow (above grade)
Digester Gas	No special cleaning required	None	Air Blow
Waste Water	No special cleaning required	None	Service Water Flush
Waste Water (U/G)	No special cleaning required	None	Service Water Flush
Compressed Air (Station Air)	No special cleaning required	None	Air Blow
Instrument Air	No special cleaning required (SS) SP6- Commercial Blast Cleaning (CS)	None (SS) Vapor phase corrosion inhibitor (water soluble preservative) (CS)	Air Blow
Nitrogen	No special cleaning required	None	Air Blow
Carbon Dioxide	No special cleaning required	None	Air Blow
Service Water	SP3 – Power Tool Cleaning	None	Service Water Flush
Fire Protection	No special cleaning required	None	Fire Water Flush
<p>Notes:</p> <p>Piping Fabrication Cleaning Methods: NO- no special cleaning required. SP3- Power tool cleaning. SP6- Commercial blast cleaning. SP8- Pickled. WJ1- Water jetting in the field to sp-12, wj1 cleanliness.</p> <p>Post-Fabrication Piping Preservative or Coating Options: 1001 – vapor phase corrossions inhibitor (water soluble preservative). 1002- oil soluble preservative. 2314- epoxy coal tar. CP- coating prohibited. NONE – manufacturer’s standard coating system or no internal coating require. Service water and demineralized water flushes should be performed with treated water as defined by the guide.</p>			

System Name	Piping Fabrication Cleaning Method ⁽¹⁾	Post-Fabrication Preservative or Coating Option ⁽²⁾	Post-Installation Cleaning ^(3,4,5)
<p>Hydro blasting may be an appropriated alternative to chemical cleaning and steam blowing for certain applications, depending on piping length and accessibility.</p> <p>Air blow post-installation cleaning should be performed with clean, dry air.</p>			

6.1.4 Insulation, Jacketing, and Lagging

Insulation and lagging will be applied to equipment, piping, valves, specialties, and ductwork as shown in Table 6-6. Insulation material for piping will be mineral fiber (Type II, per ASTM C547), and jacketing material will be stucco-embossed aluminum. A minimum jacketing thickness of 0.016 inch will be used. Insulation and lagging will be designed for conditions of 75° F ambient, emissivity of 0.09, no incident solar heating, and 2 mph airflow velocity, for a normal operating calculated surface temperature of 150° F using the method defined in ASTM Standard C680. For pipe and equipment with an operating temperature of 600° F or higher, two layers of insulation with fully staggered offset joints/seams will be used.

Table 6-6 Insulation and Lagging Requirements

Max. Op. Temp.	Nominal Insulation Thickness (in.) vs. Nominal Pipe Diameter (in.)										
	0.50	0.75	1.00	1.25	2.00	2.50	3.00	4.00	6.00	8.00	
1,000	2.00	2.50	2.50	3.00	3.00	3.00	3.50	4.00	4.50	4.50	
800	1.50	1.50	1.50	1.50	2.00	2.00	2.50	2.50	3.00	3.00	
600	1.00	1.00	1.00	1.00	1.50	1.50	1.50	1.50	2.00	2.00	
500	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.50	1.50	
400	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
300	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
200	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Max. Op. Temp.	Nominal Insulation Thickness (in.) vs. Nominal Pipe Diameter (in.)										
	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00	30.00	36.00	48.00
1,000	5.00	5.50	5.50	6.00	6.00	6.00	6.00	6.50	6.50	7.00	7.50
800	3.50	3.50	3.50	4.00	4.00	4.00	4.00	4.00	4.50	4.50	5.00
600	2.00	2.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50	3.00	3.00
500	1.50	1.50	1.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
400	1.00	1.00	1.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
300	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The following specific situations may deviate from the above guidelines:

- Pipe, tubing, and valves over 150° F, but that are not accessible (not within seven feet vertically or three feet horizontally) to personnel during normal operations and that do not require heat loss prevention, need not be insulated. Examples are hot drain piping, vent stacks, vents, compressed air and gas lines, sulfur trioxide lines, and similar items selected by Black & Veatch.
- Anti-sweat insulation shall be applied to piping, equipment, and ductwork where ambient and process temperature creates a potential for condensation on the exterior surface.
- Piping, tubing, instruments, and equipment requiring freeze protection as indicated in Section 6.1.5.

6.1.5 Freeze Protection

Freeze protection design criteria are shown in Table 6-7.

Table 6-7 Freeze Protection Design Criteria

Main Design Criteria	
Minimum Ambient Temperature	20 °F
Wind Speed	19.1 mph
Maximum Pipe Radius Frozen	10%
Acceptable Time to Freeze (Plant operators must drain stagnant piping systems within this time frame)	8 hours
Electric Heat Tracing Criteria (Liquid Service Piping Exposed to Freezing Conditions)	
≤2-inch NPS	None
≥ 2-1/2-inch NPS	None

6.1.6 Process Temperature Maintenance

Refer to 6.1.4 for minimum insulation thickness based on operating temperature. Heat or steam tracing is not required for any process piping temperature maintenance.

6.1.7 Space Conditioning

Space conditioning is only expected to be required for new electrical/control system buildings.

6.1.8 Fire Protection

The fire protection review, and hazard assessment will be conducted once the layout of new equipment has been further developed. At that time, modifications or additions to the existing plant fire protection system and/or equipment will be further defined and reflected in this document.

7.0 Electrical Design Basis

7.1 DESIGN CRITERIA

7.1.1 Electrical Power Available at Battery Limits

The new plant electrical system design is dictated by the local utility distribution source available and the plant electrical loads. The system voltage levels and design shall be according to the project one-line diagram and the below.

- MV Distribution 4.16kV, 60Hz, 3-Phase (Not currently envisioned).
- LV Distribution 480V, 60Hz, 3-Phase.

7.1.2 Electric Motors

Motors shall be purchased with the driven equipment, and be in accordance with NEMA MG1 and the following:

- MV Motors: 4000V, 250HP and larger, 1.0 service factor, class B temp rise, class F insulation.
- LV Motors: 460V, ½ to 249HP, 1.0 service factor, class B temp rise, class F insulation.
- Single-Phase Motors: 120V, Up to 1/3 HP.

7.1.3 Uninterruptible Power Supply, Battery Systems, and Emergency Power

Critical plant ac and dc loads will be powered from an uninterruptible power system (UPS) or battery system. The UPS will power items such as DCS, programmable logic controllers (PLCs), network equipment, and critical instruments and equipment. The battery system will power items such as switchgear relays and operational power, UPS, and critical motors.

The DC battery and UPS will be provided as follows:

- Duty Cycle: 2 hours.
- DC Battery: 125VDC.
- UPS: 120VAC, 1-phase.

An emergency generation system will serve emergency power if required to safely shut down the facility.

7.1.4 Classification of Hazardous Areas

Hazardous area classification is determined by the Electrical Project Discipline Engineer, according to NFPA and other applicable codes. The Mechanical Project Discipline Engineer is responsible for space control and life safety issues. This will be addressed once equipment layout has been determined.

7.1.5 Grounding

The plant grounding system will follow the recommendations of the NEC.

- Bare copper grounding conductor insulated where installed in conduit.
- Copper-clad, ¾ inch x 10-foot section ground rods.
- Exothermic junction bonding method.

7.1.6 Lightning Protection

The plant is in a location of relatively low number of thunderstorm days per year, however, lightning protection will be provided on any new large buildings. The system will consist of air terminals, interconnecting conductors, down conductors with connection to the grounding system, and bonding of metal objects on or within the structure. Conductors shall be copper.

7.1.7 Lighting

Lighting systems shall be as follows:

- Office, control room, and electrical rooms shall be LED.
- Indoor high bay, outdoor platforms, outdoor above doors, hazardous areas, and any roadway lighting shall be high-pressure sodium.
- Emergency lighting shall be provided for egress utilizing integral fixture battery packs.
- Outdoor lighting shall be controlled by photoelectric controllers and control switch.

7.1.8 Wiring and Raceways

Ampacities of cable in cable tray are based on NFPA-70 (NEC). The following cable types may be grouped in common cable trays with other cables of the same type:

- Medium voltage cables.
- 600-volt power cable.
- Control cables.
- Instrument analog.
- Cable construction shall be as shown in Table 7-1.

Table 7-1 Cable Construction

Voltage Level/Application	Minimum Cable Construction
Medium Voltage Power	1/c EPR insulation, copper tape- shielded, FR-PVC jacket, 133% insulation
Low Voltage Power	1/c FR-XLPE insulation without jacket (RHH/RHW-2/USE-2) or 3/c XLPE or EPR insulation, FR- PVC jacket
Low Voltage Control	XLPE or EPR insulation, FR-PVC jacket
Instrument - 300 V	PVC or PVC/Nylon insulation, FR- PVC jacket
Instrument Thermocouple Extension Wire - 300 V	PVC insulation, FR-PVC jacket
Grounding	Bare conductor or 1/c THHN/THWN, green insulation
Lighting - Interior at 120 V	1/c THHN/THWN insulation
Lighting - Exterior and interior greater than 120 V	1/c XHHW-2 insulation
Note: Special application cables are not listed.	

Raceway materials shall be as shown in Table 7-2:

Table 7-2 Raceway Materials

Raceway System	Material/Construction
Duct Bank (horizontal runs)	PVC Schedule 40 RGS (when required for shielding)

	2-inch separation between tubes
Duct Bank Risers (all tubes including elbows)	RGS
Cable Tray - Ladder	Aluminum
Cable Tray (wet or corrosive areas)	Aluminum or fiberglass
Conduit (general purpose)	
Conduit	RGS
Lighting and Communication Circuits (indoors, nonhazardous locations)	EMT
Circuits (outdoors, hazardous locations)	RGS
Direct Buried PVC (underground)	PVC Schedule 40
Conduit Fittings	RGS - Malleable iron

7.1.9 Plant Communication

A plantwide communication or paging system will not be provided and will rely on handheld radios for any required communication between personnel.

7.1.10 Electrical Freeze Protection and Temperature Maintenance

Piping freeze protection and temperature maintenance systems may be required for outdoor piping, instruments, and equipment devices subject to cold weather. In the cases where it is needed, heat trace control panels and respective power transformers will be provided in strategic areas to serve this need. Refer to section 6.0 Mechanical Design Basis for further information.

Appendix C. Site Visit Memorandum

MEMORANDUM

Pacific Gas and Electric Company (PG&E)
Monterey Park Tract (MPT) Gas Microgrid Support
Trinkler Dairy Site Visit

B&V Project Number 401616
B&V File Number 40.3100
29 March 2019

To: Jamie Randolph, Principal Interconnection Manager, PG&E
From: Jim Easterly, Project Manager, Black & Veatch

Address:
Trinkler Farm
7251 Crows Landing Road
Ceres, CA 95307

Contact

Jon Rebiero, Trinkler Dairy Farms, Inc.
Email: jrebiero@trinklerfarms.com

Site Visit Participants

Jamie Randolph, Principal Interconnection Manager (PG&E)
Mary Diebert, Account Manager (PG&E)
Joerg Blischke, Senior Process and Organics Management Specialist (B&V)
Matthew Prather, Environmental Regulatory Licensing Specialist (B&V)

Site Description

The Trinkler Dairy Farm is located at 7251 Crows Landing Road, at the southwest corner of the Crows Landing and West Taylor Roads intersection, west of the City of Ceres in Stanislaus County, CA. The MPT residential subdivision is located approximately 650 feet west of the site's southwestern property line.

The site includes:

- Four homes
- Dairy facility structures
 - Animal barns (milking cows, dry cows, heifers and calves)
 - Milk barn
 - Ancillary equipment
- Groundwater wells
- Backup generator
- Propane tank
- Feed storage (covered and outdoors)
- Mechanical screening and overs storage
- Two wastewater lagoons

Synopsis of Information Obtained during Site Visit

Animal head count

- Approximately 1,500 milking cows
- Approximately 1,500 non-milking cows (dry cows, heifers and calves)
- Farm applied for and received use permit from Stanislaus County for doubling the number of milking cows in their operation, but are not sure at the moment when expansion will start
- Consensus was reached by site visit attendees that the MPT Gas Microgrid Project will use the current animal headcount for the basis of design

Liquid Stream Management

- Manure management
 - Pens are flushed with recycled water from wastewater storage lagoon #2 (WWSL2) throughout the year
 - In the summer months (Jun/Jul/Aug) water flushing demand is supplemented with well water of up to 50% by volume
 - The flushing cycle for the different barn/pan areas is timer controlled; on an 8-hr cycle
 - Each pen is flushed twice a day
 - Flushed wastewater from the pens are routed by gravity to two sumps, which are controlled by float switches; the output from these pumps is feed through two outdoor elevated screens (installed in parallel) for coarse material (mostly fiber) removal
 - Screen overs are removed via a moving belt scraper and discharged by gravity onto the paved floor below
 - Screen overs are used as farm crop fertilizer, applied twice a year (Spring and Fall)
 - Farm is considering using material for animal bedding in the future
 - Centrate/filtrate is routed by gravity via pipes into wastewater storage lagoon #1 (WWSL1)
 - Current screen size is not known; Trinkler had tested with smaller screen size to recover more fibers but smaller screens were prone to plugging
 - Current screen has been in operation for the last 5 years without known operational issues
 - Wastewater from WWSL1 can be routed via overflow weir or transfer pump to WWSL2
 - Normal transfer operation: transfer pump from WWSL1 to WWSL2 is operated at the same time as the WWSL2 discharge pump for pen flushing to maintain equilibrium between the two lagoons
 - Location of WWSL2 sump pump for flushing is not clear; either on NW corner of WWSL2 or mounted on floating pontoon towers in the NW lagoon area
 - WWSL2 capacity appears to be almost double the capacity of WWSL1
 - Amount of produced manure, qualities of flushing water used (recycled and well) and overall flow to WWSL1 lagoon were not provided during the site visit
 - WWSL1 (and possibly WWSL2) cleaning schedule is once or twice per year

- Trinker has not previously experienced a lagoon overflow/spillage event; when wastewater liquid level is moving to a critical level then wastewater from WWSL2 is used for field irrigation
- The capacities of the transfer and recycle pump are 600 gpm each
- Characterization of manure (and recycled flush water): no lab data available on characteristics of wastewater feeding the screen nor centrate/filtrate sent to WWLS1; the Waste Management Plan (or Nutrient Management Plan) may contain data on the characteristics of the WWLS2 effluent
- Asked if the Farm would consider or has considered switching from flush to scrape manure operation: not at this time, as it would require additional investments for equipment plus increases labor (biggest issue)
- Milk parlor
 - Milking cows are milked twice a day
 - Floor flushed/cleaned with well water; discharged to the sump feeding WWSL1
 - Amount of water for flushing was not known during site visit
- Stormwater management
 - Rain water from roof of barns are collected in gutter and routed to the sump feeding WWSL1
 - Rainwater and any other water for cleaning/flushing of the paved area is routed to a low-point catch basin from where an in-ground pipe is connected to one of the manure collection sumps (flow by gravity into sump)

Permitting

- Jon confirmed that the site is covered under the Regional Water Quality Control Board Dairy General Permit for wastewater
- Farm received approval of application from Stanislaus County for expansion of the project via use permit and has a good relationship with the county and surrounding community
- Farm received San Joaquin Valley Air Pollution Control District Approval for expansion
- Site must begin construction or submit for an extension by the end of the 2019

Utilities

- One propane tank is used for heating process water to support the dairy operation
- One back-up diesel-fueled generator
- Power feed for facility:
 - From power pole and line entering the property from Crows Landing Road running West
 - Another power line runs along W. Taylor Road (East-West axis); one of the irrigation pumps fed from the surface water supply ditch for field irrigation is connected to this line
 - Another sump pump on the WWSL2 discharge site (for recycled water; on the NW corner of WWSL2) is connected to this power line as well.
 - Jon was not aware of any specific capacity constraints with respect to utilities

Other Information

- Available land for new digester: east of WWSL2
- Possible/preferred location for CNG upgrading and fueling station: west or southwest of WWSL2; access via dirt road off Taylor Rd. running South
- Discussed various new digester implementation and operation options; Jon appears to prefer having the digester and biogas upgrading complex be operated by a third party, but this may change as the project evolves
- Jon is not aware of any odor complaints from adjacent neighbors
- Geotechnical information: Jon was not aware of any boring and soil analysis for the Farm; some geotechnical information may be found in the application for Use Permit for Dairy Operation expansion that may include the addition of a WWSL
- Dairy Farm objective for this project: reduce methane emissions from the dairy operation appears to be a key motivator
- Willingness of adjacent farms to transport their manure to Trinkler for disposition via anaerobic digestion (AD) and interactions with other AD developers
 - Did not discuss this topic specifically, but Mary mentioned that PG&E had reached out to other adjacent dairies with little traction
 - Jon had only initial discussions with another AD project developer about a year ago but couldn't recall the name

Follow-up Information Request for Trinkler Farms

- Animal population count/type
- Bedding material type
- Location of WWSL2 sump pump for flushing
- Drawings for storage lagoon design and capacity
- Trinkler Waste Management Plan

Appendix D. Mass and Energy Balance

CASE: Summer										
STREAM NUMBER	1	2	3	4	5	6	7	8	9	10
STREAM DESCRIPTION	Raw Manure and Bedding from Barn	Recycled Water from WWSL2 to Barn	Well Water to Parlor	Parlor Wastewater	Combined Flow from Barns to Recovery	Separated Solids / Recovered Fiber	Influent to Digester	Rainwater to WWSL2	Effluent from WWSL2 to Irrigation	AD Process Loss
STREAM PROPERTIES										
Temperature	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	100.0
Pressure	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
Mass Flowrate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Volumetric Flowrate at T & P	9,121	9,121	9,408	9,759	110,091	2,960	107,130	56,262	71,666	26
Phase	Liquid / Solid	Liquid	Liquid	Liquid	Liquid	Liquid / Solid	Liquid	Liquid	Liquid	Gas
VAPOR PROPERTIES										
Mass Flowrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	26
Volumetric Flowrate at T & P	NA	NA	NA	NA	NA	NA	NA	NA	NA	409.5
Volumetric Flowrate at STP	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.4
Density	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.067
Heat Capacity	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.415
LIQUID PROPERTIES										
Mass Flowrate	9,121	9,121	9,408	9,759	110,091	2,960	107,130	56,262	71,666	NA
Volumetric Flowrate at T & P	146.4	1,461.7	150.8	156.4	1,764.5	47.4	1,716.8	901.6	1,148.5	NA
Density	62.3	62.4	62.4	62.4	62.4	62.5	62.4	62.4	62.4	NA
Heat Capacity	NA	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	NA
COMPOSITION, lb/hr										
Water	7,781.71	90,754.36	9,407.75	9,690.63	108,226.70	2,309.10	105,917.59	56,261.90	71,307.78	0.11
Manure TS	NA	456.05	0.00	68.69	1,864.08	651.29	1,212.79	0.00	358.33	NA
Manure VS	NA	250.83	0.00	58.69	1,453.97	488.46	965.51	0.00	197.08	NA
Methane	16.043	NA	NA	NA	NA	NA	NA	NA	NA	10.63
Carbon Dioxide	44.011	NA	NA	NA	NA	NA	NA	NA	NA	14.27
Nitrogen	28.014	NA	NA	NA	NA	NA	NA	NA	NA	0.54
Oxygen	32.000	NA	NA	NA	NA	NA	NA	NA	NA	0.16
Hydrogen Sulfide	34.076	NA	NA	NA	NA	NA	NA	NA	NA	0.07
Carbon Monoxide	28.011	NA	NA	NA	NA	NA	NA	NA	NA	NA
NO2	46.006	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Dioxide	64.064	NA	NA	NA	NA	NA	NA	NA	NA	NA
VOCs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	9,121.04	91,210.42	9,407.75	9,759.32	110,090.77	2,960.39	107,130.38	56,261.90	71,666.11	25.79

CASE: Summer										
STREAM NUMBER	11	12	13	14	15	16	17	18	19	20
STREAM DESCRIPTION	Digestate from Digester to IWWSLZ	Raw Biogas to Compression	Compressed Dry Biogas to Cleaning System	Biogas Condensate to Digester	Biogas Cleaning System Off-Gas to Thermal Oxidizer	Thermal Oxidizer Emissions	RNG to PoR	RNG from PoR	RNG to Local/Trinkler Vehicles	RNG to MPT
STREAM PROPERTIES										
Temperature	80.0	100.0	40.0	40.0	100.0	1,200.0	100.0	100.0	100.0	100.0
Pressure	14.7	14.7	214.7	14.7	15.7	14.7	3,614.7	3,614.7	3,614.7	3,614.7
Mass Flowrate	0.0	0.0	200.0	0.0	1.0	0.0	3,600.0	3,600.0	3,600.0	3,600.0
Volumetric Flowrate at T & P	106,615	490	487	2	280	385	208	206	35	7
Phase	Liquid	Gas	Gas	Liquid	Gas	Gas	Gas	Gas	Gas	Gas
VAPOR PROPERTIES										
Mass Flowrate	NA	490	487	NA	280	385	208	206	35	7
Volumetric Flowrate at T & P	NA	7,782.6	480.3	NA	2,575.8	NA	20.7	20.5	3.4	0.7
Volumetric Flowrate at STP	NA	122.3	120.7	NA	43.2	NA	80.0	79.2	13.3	2.5
Density	NA	0.067	1.013	NA	0.109	NA	10.025	10.025	10.025	10.025
Heat Capacity	NA	0.415	0.415	NA	0.23	NA	0.527	0.527	0.527	0.527
LIQUID PROPERTIES										
Mass Flowrate	106,615	NA	NA	2	NA	NA	NA	NA	NA	NA
Volumetric Flowrate at T & P	1,708.6	NA	NA	0.0	NA	NA	NA	NA	NA	NA
Density	62.4	NA	NA	62.4	NA	NA	NA	NA	NA	NA
Heat Capacity	1.00	NA	NA	1.00	NA	NA	NA	NA	NA	NA
COMPOSITION, lb/hr	MW									
Water	18.016	105,915.39	0.00	2.09	0.00	NA	0.00	0.00	0.00	0.00
Manure TS	NA	697.04	NA	NA	NA	NA	NA	NA	NA	NA
Manure VS	NA	449.76	NA	NA	NA	NA	NA	NA	NA	NA
Methane	16.043	NA	202.01	202.01	10.10	NA	191.91	189.99	31.97	6.09
Carbon Dioxide	44.011	NA	271.13	271.13	266.12	382.36	5.00	4.95	0.83	0.16
Nitrogen	28.014	NA	10.31	10.31	0.00	NA	10.31	10.21	1.72	0.33
Oxygen	32.000	NA	3.10	3.10	2.73	NA	0.37	0.37	0.06	0.01
Hydrogen Sulfide	34.076	NA	1.32	0.00	1.32	NA	NA	NA	NA	NA
Carbon Monoxide	28.011	NA	NA	NA	NA	0.02	NA	NA	NA	NA
NO2	46.006	NA	NA	NA	NA	0.06	NA	NA	NA	NA
Sulfur Dioxide	64.064	NA	NA	NA	NA	2.48	NA	NA	NA	NA
VOCs	NA	NA	NA	NA	NA	0.39	NA	NA	NA	NA
Total		489.96	486.55	2.09	280.27	385.32	207.60	205.52	34.58	6.59



CLIENT: PGE
 PROJECT NAME: MPT Gas Microgrid
 PROJECT NUMBER: 401616
 CASE: Summer
 LOCATION: Ceres, CA
 Rev B

CASE: Summer	
STREAM NUMBER	21
STREAM DESCRIPTION	RNG to Tube Trailers
STREAM PROPERTIES	
Temperature	F 100.0
Pressure	psia 3,614.7
	psig 3,600.0
Mass Flowrate	lb/hr 164
Volumetric Flowrate at T & P	ft3/hr 16.4
Phase	Gas
VAPOR PROPERTIES	
Mass Flowrate	lb/hr 164
Volumetric Flowrate at T & P	ft3/hr 16.4
Volumetric Flowrate at STP	ft3/min 63.4
Density	lb/ft3 10.025
Heat Capacity	Btu/lb-F 0.527
LIQUID PROPERTIES	
Mass Flowrate	lb/hr NA
Volumetric Flowrate at T & P	ft3/hr NA
Density	lb/ft3 NA
Heat Capacity	Btu/lb-F NA
COMPOSITION, lb/hr	
Water	MW 18.016 0.00
Manure TS	NA NA
Manure VS	NA NA
Methane	16.043 151.93
Carbon Dioxide	44.011 3.96
Nitrogen	28.014 8.16
Oxygen	32.000 0.29
Hydrogen Sulfide	34.076 NA
Carbon Monoxide	28.011 NA
NO2	46.006 NA
Sulfur Dioxide	64.064 NA
VOCs	NA NA
Total	164.35

CASE: Winter										
STREAM NUMBER	1	2	3	4	5	6	7	8	9	10
STREAM DESCRIPTION	Raw Manure and Bedding from Barn	Recycled Water from WWSL2 to Barn	Well Water to Parlor	Parlor Wastewater	Combined Flow from Barns to Fiber Recovery	Separated Solids / Recovered Fiber	Influent to Digester	Rainwater to WWSL2	Effluent from WWSL2 to Irrigation	AD Process Loss
STREAM PROPERTIES										
Temperature	F	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	70.0
Pressure	psia	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
Mass Flowrate	psig	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Volumetric Flowrate at T & P	lb/hr	11,348	113,476	9,408	9,877	134,700	131,078	56,262	73,379	24
Phase	ft ³ /hr	182.2	1,818.5	150.8	158.3	2,159.0	2,100.6	901.6	1,175.9	364.7
	Liquid / Solid	Liquid	Liquid	Liquid	Liquid	Liquid / Solid	Liquid	Liquid	Liquid	Gas
VAPOR PROPERTIES										
Mass Flowrate	lb/hr	NA	NA	NA	NA	NA	NA	NA	NA	24
Volumetric Flowrate at T & P	ft ³ /hr	NA	NA	NA	NA	NA	NA	NA	NA	364.7
Volumetric Flowrate at STP	ft ³ /min	NA	NA	NA	NA	NA	NA	NA	NA	6.1
Density	lb/ft ³	NA	NA	NA	NA	NA	NA	NA	NA	0.067
Heat Capacity	Btu/lb-F	NA	NA	NA	NA	NA	NA	NA	NA	0.415
LIQUID PROPERTIES										
Mass Flowrate	lb/hr	11,348	113,476	9,408	9,877	134,700	131,078	56,262	73,379	NA
Volumetric Flowrate at T & P	ft ³ /hr	182.2	1,818.5	150.8	158.3	2,159.0	2,100.6	901.6	1,175.9	NA
Density	lb/ft ³	62.3	62.4	62.4	62.4	62.4	62.4	62.4	62.4	NA
Heat Capacity	Btu/lb-F	NA	1.00	1.00	1.00	1.00	1.00	1.00	1.00	NA
COMPOSITION, lb/hr										
Water	18.016	112,908.66	9,407.75	9,790.81	132,380.79	2,825.28	1,295,555.51	56,261.90	73,011.62	0.10
Manure TS	NA	567.38	0.00	85.70	2,319.36	796.87	1,522.49	0.00	366.89	NA
Manure VS	NA	312.06	0.00	73.23	1,809.11	597.65	1,211.46	0.00	201.79	NA
Methane	16.043	NA	NA	NA	NA	NA	NA	NA	NA	10.01
Carbon Dioxide	44.011	NA	NA	NA	NA	NA	NA	NA	NA	13.43
Nitrogen	28.014	NA	NA	NA	NA	NA	NA	NA	NA	0.51
Oxygen	32.000	NA	NA	NA	NA	NA	NA	NA	NA	0.15
Hydrogen Sulfide	34.076	NA	NA	NA	NA	NA	NA	NA	NA	0.07
Carbon Monoxide	28.011	NA	NA	NA	NA	NA	NA	NA	NA	NA
NO2	46.006	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Dioxide	64.064	NA	NA	NA	NA	NA	NA	NA	NA	NA
VOCs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total		11,347.60	113,476.04	9,407.75	9,876.50	134,700.15	131,078.00	56,261.90	73,378.51	24.27

CASE: Winter		11	12	13	14	15	16	17	18	19	20
STREAM NUMBER	STREAM DESCRIPTION	Digestate from Digester to IWWSLZ	Raw Biogas to Compression	Compressed Dry Biogas to Cleaning System	Biogas Condensate to Digester	Biogas Cleaning System Off-Gas to Thermal Oxidizer	Thermal Oxidizer Emissions	RNG to PoR	RNG from PoR	RNG to Local/Trinkler Vehicles	RNG to MPT
STREAM PROPERTIES											
Temperature	F	50.0	70.0	40.0	40.0	100.0	1,200.0	100.0	100.0	100.0	100.0
Pressure	psia	14.7	14.7	214.7	14.7	15.7	14.7	3,614.7	3,614.7	3,614.7	3,614.7
Mass Flowrate	psig	0.0	0.0	200.0	0.0	0.0	0.0	3,600.0	3,600.0	3,600.0	3,600.0
Volumetric Flowrate at T & P	lb/hr	130,593	461	458	2	264	368	195	193	35	7
Phase	ft3/hr	2,092.8	6,931.5	452.0	0.0	2,424.0	NA	19.5	19.3	3.4	0.7
		Liquid	Gas	Gas	Liquid	Gas	Gas	Gas	Gas	Gas	Gas
VAPOR PROPERTIES											
Mass Flowrate	lb/hr	NA	461	458	NA	264	368	195	193	35	7
Volumetric Flowrate at T & P	ft3/hr	NA	6,931.5	452.0	NA	2,424.0	NA	19.5	19.3	3.4	0.7
Volumetric Flowrate at STP	ft3/min	NA	115.1	113.4	NA	40.7	NA	75.3	74.6	13.3	2.5
Density	lb/ft3	NA	0.067	1.013	NA	0.109	NA	10.025	10.025	10.025	10.025
Heat Capacity	Btu/lb-F	NA	0.415	0.415	NA	0.23	NA	0.527	0.527	0.527	0.527
LIQUID PROPERTIES											
Mass Flowrate	lb/hr	130,593	NA	NA	2	NA	NA	NA	NA	NA	NA
Volumetric Flowrate at T & P	ft3/hr	2,092.8	NA	NA	0.0	NA	NA	NA	NA	NA	NA
Density	lb/ft3	62.4	NA	NA	62.4	NA	NA	NA	NA	NA	NA
Heat Capacity	Btu/lb-F	1.00	NA	NA	1.00	NA	NA	NA	NA	NA	NA
COMPOSITION, lb/hr											
Water	MW	129,553.44	1.97	0.00	1.97	0.00	NA	0.00	0.00	0.00	0.00
Manure TS	NA	1,037.14	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manure VS	NA	726.11	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methane	16.043	NA	190.10	190.10	NA	9.51	NA	180.60	178.79	31.97	6.09
Carbon Dioxide	44.011	NA	255.14	255.14	NA	250.44	365.06	4.71	4.66	0.83	0.16
Nitrogen	28.014	NA	9.70	9.70	NA	0.00	NA	9.70	9.61	1.72	0.33
Oxygen	32.000	NA	2.92	2.92	NA	2.57	NA	0.35	0.35	0.06	0.01
Hydrogen Sulfide	34.076	NA	1.24	0.00	NA	1.24	NA	NA	NA	NA	NA
Carbon Monoxide	28.011	NA	NA	NA	NA	NA	0.02	NA	NA	NA	NA
NO2	46.006	NA	NA	NA	NA	NA	0.06	NA	NA	NA	NA
Sulfur Dioxide	64.064	NA	NA	NA	NA	NA	2.33	NA	NA	NA	NA
VOCs	NA	NA	NA	NA	NA	NA	0.38	NA	NA	NA	NA
Total		130,590.58	461.08	457.87	1.97	263.75	367.85	195.36	193.41	34.58	6.59



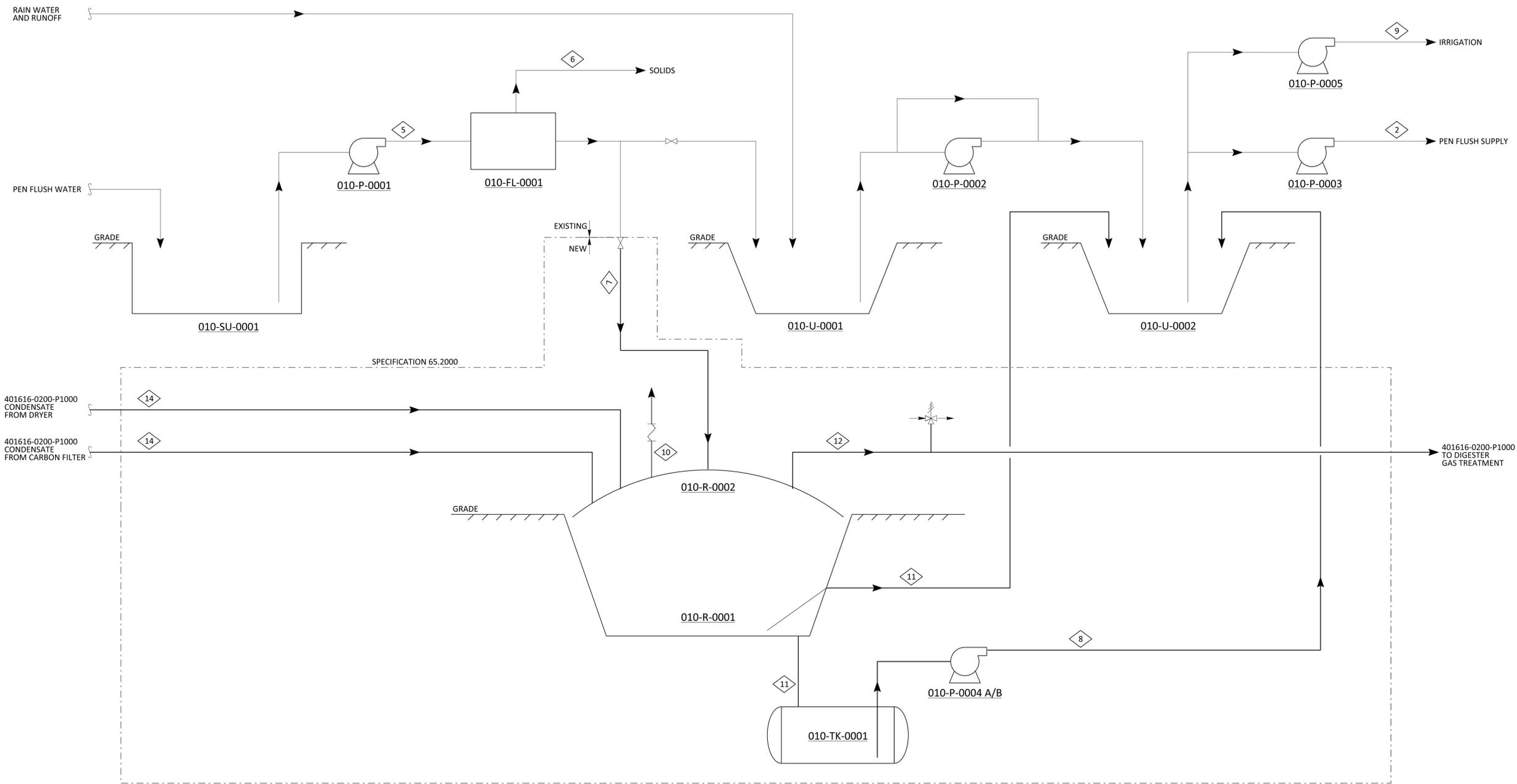
CLIENT: PGE
 PROJECT NAME: MPT Gas Microgrid
 PROJECT NUMBER: 401616
 CASE: Winter
 LOCATION: Ceres, CA
 Rev B

CASE: Winter		21
STREAM NUMBER	RNG to Tube Trailers	
STREAM DESCRIPTION		
STREAM PROPERTIES		
Temperature	F	100.0
Pressure	psia	3,614.7
	psig	3,600.0
Mass Flowrate	lb/hr	152
Volumetric Flowrate at T & P	ft3/hr	15.2
Phase	Gas	
VAPOR PROPERTIES		
Mass Flowrate	lb/hr	152
Volumetric Flowrate at T & P	ft3/hr	15.2
Volumetric Flowrate at STP	ft3/min	58.7
Density	lb/ft3	10.025
Heat Capacity	Btu/lb-F	0.527
LIQUID PROPERTIES		
Mass Flowrate	lb/hr	NA
Volumetric Flowrate at T & P	ft3/hr	NA
Density	lb/ft3	NA
Heat Capacity	Btu/lb-F	NA
COMPOSITION, lb/hr		
Water	18.016	0.00
Manure TS	NA	NA
Manure VS	NA	NA
Methane	16.043	140.73
Carbon Dioxide	44.011	3.67
Nitrogen	28.014	7.56
Oxygen	32.000	0.27
Hydrogen Sulfide	34.076	NA
Carbon Monoxide	28.011	NA
NO2	46.006	NA
Sulfur Dioxide	64.064	NA
VOCs	NA	NA
Total		152.23

Appendix E. Process Flow Diagram

- 010-SU-0001 WASHDOWN SUMP (EXISTING)
- 010-P-0001 WASHDOWN PUMP (EXISTING)
- 010-FL-0001 SOLIDS REMOVAL SCREEN (EXISTING)
- 010-R-0001 LAGOON DIGESTER PLUS LINER
- 010-R-0002 LAGOON DIGESTER COVER
- 010-TK-0001 LAGOON ACCUMULATION TANK
- 010-P-0004 A/B RAIN WATER SUMP PUMP
- 010-U-0001 WASTEWATER STORAGE LAGOON #1 (EXISTING)
- 010-P-0002 WASTEWATER TRANSFER PUMP (EXISTING)
- 010-U-0002 WASTEWATER STORAGE LAGOON #2 (EXISTING)
- 010-P-0003 WASTEWATER RECYCLE PUMP (EXISTING)
- 010-P-0005 WASTEWATER IRRIGATION PUMP (EXISTING)

- NOTES
1. EACH PEN IS FLUSHED TWO TIMES PER DAY.
 2. IN JUNE, JULY & AUGUST FLUSH WATER IS SUPPLEMENTED WITH WELL WATER OF UP TO 50% BY VOLUME.
 3. THE FLUSHING CYCLE FOR THE DIFFERENT BARN/PEN AREAS IS ON AN 8-HOUR CONTROLLED TIMER.



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 - - - EXISTING
 ◇ STREAM NUMBER

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B	4/23/2019	ISSUED FOR RFQ	RJB	ODH	MCH	MCH	JMC
A	4/10/2019	ISSUED FOR CLIENT REVIEW	RJB	ODH	MCH	MCH	JMC

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF CALIFORNIA.

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 DATE: _____

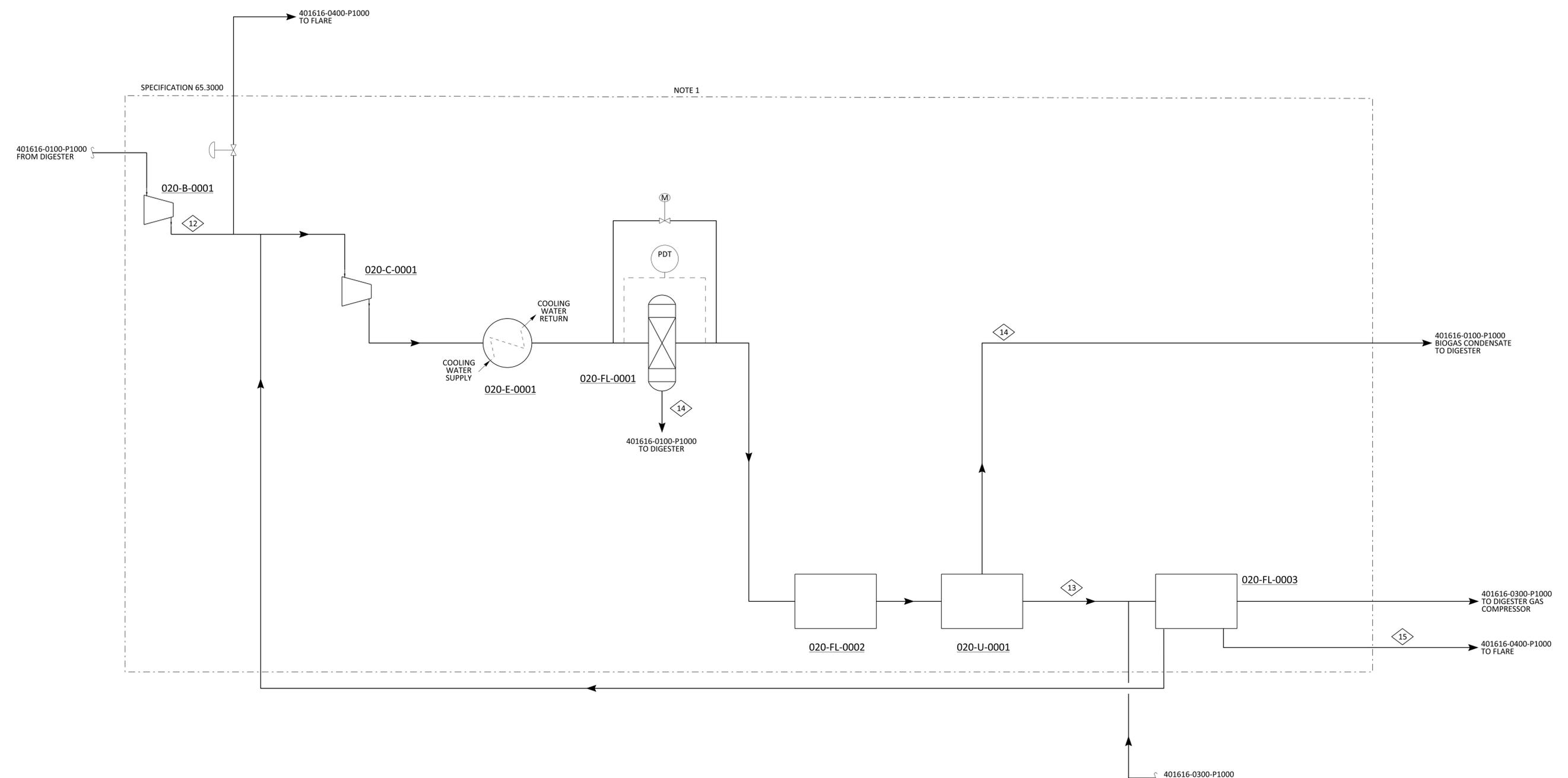
PACIFIC GAS & ELECTRIC
 MONTEREY PARK TRACT GAS MICROGRID SUPPORT

PROCESS FLOW DIAGRAM
 ANAEROBIC DIGESTION

PROJECT	DRAWING NUMBER	REV
401616-0100-P1000	401616-0100-P1000	B
CODE	AREA	

020-B-0001 DIGESTER GAS BLOWER
 020-F-0001 FLARE
 020-C-0001 DIGESTER GAS FEED COMPRESSOR
 020-E-0001 DIGESTER GAS AFTER-COOLER
 020-FL-0001 DIGESTER PRETREATMENT FILTER
 020-FL-0002 H2S REMOVAL
 020-U-0001 DRYER
 020-FL-0003 MEMBRANE GAS SEPARATION

NOTES:
 1. FINAL CONFIGURATION TO BE CONFIRMED UPON PURCHASE OF EQUIPMENT



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 - - - EXISTING
 ◇ STREAM NUMBER

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NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
C	5/6/2019	CLIENT/VENDOR REVIEW REVISION	ODH	ODH	MCH	MCH	JMC
B	4/23/2019	ISSUED FOR RFQ	RJB	ODH	MCH	MCH	JMC
A	4/10/2019	ISSUED FOR CLIENT REVIEW	RJB	ODH	MCH	MCH	JMC

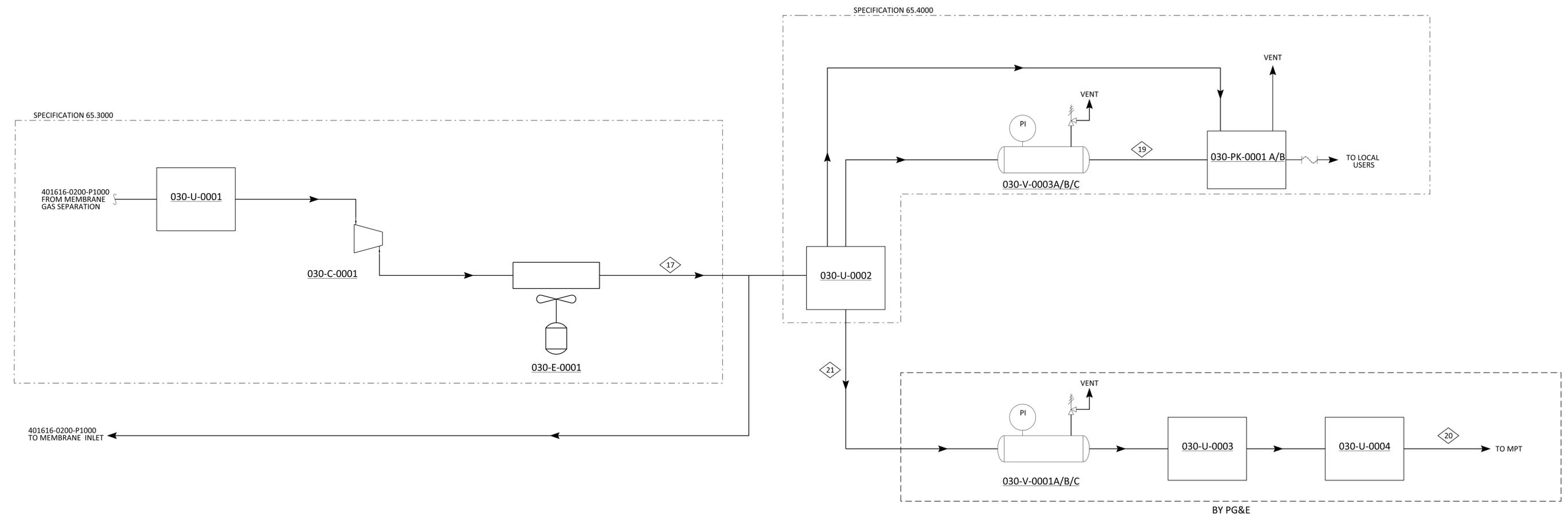
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 SIGNED _____ DATE _____ REG. NO. _____

BLACK & VEATCH
 DESIGNER: ODH, DRAWN: RJB
 CHECKED: MCH, DATE: _____

PACIFIC GAS & ELECTRIC
 MONTEREY PARK TRACT GAS MICROGRID SUPPORT
 PROCESS FLOW DIAGRAM
 DIGESTER GAS TREATMENT

PROJECT	DRAWING NUMBER	REV
401616-0200-P1000	401616-0200-P1000	C
CODE	AREA	

030-U-0001 POINT OF RECEIPT AND ODORIZATION
 030-C-0001 RNG COMPRESSOR
 030-E-0001 RNG AFTER-COOLER
 030-U-0002 PRIORITY PANEL
 030-V-0001A/B/C TUBE TRAILER
 030-V-0003A/B/C DISPENSER STORAGE VESSEL
 030-PK-0001A/B RNG DISPENSER
 030-U-0003 HIGH/LO PSI REGULATION & HEAT EXCHANGE
 030-U-0004 MONTEREY PARK TRACT INTERCONNECT TO DISTRIBUTION PIPELINE



LEGEND
 — NEW
 - - - EXISTING
 ◇ STREAM NUMBER

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NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
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B	4/23/2019	ISSUED FOR RFQ	RJB	ODH	MCH	MCH	JMC
A	4/10/2019	ISSUED FOR CLIENT REVIEW	RJB	ODH	MCH	MCH	JMC

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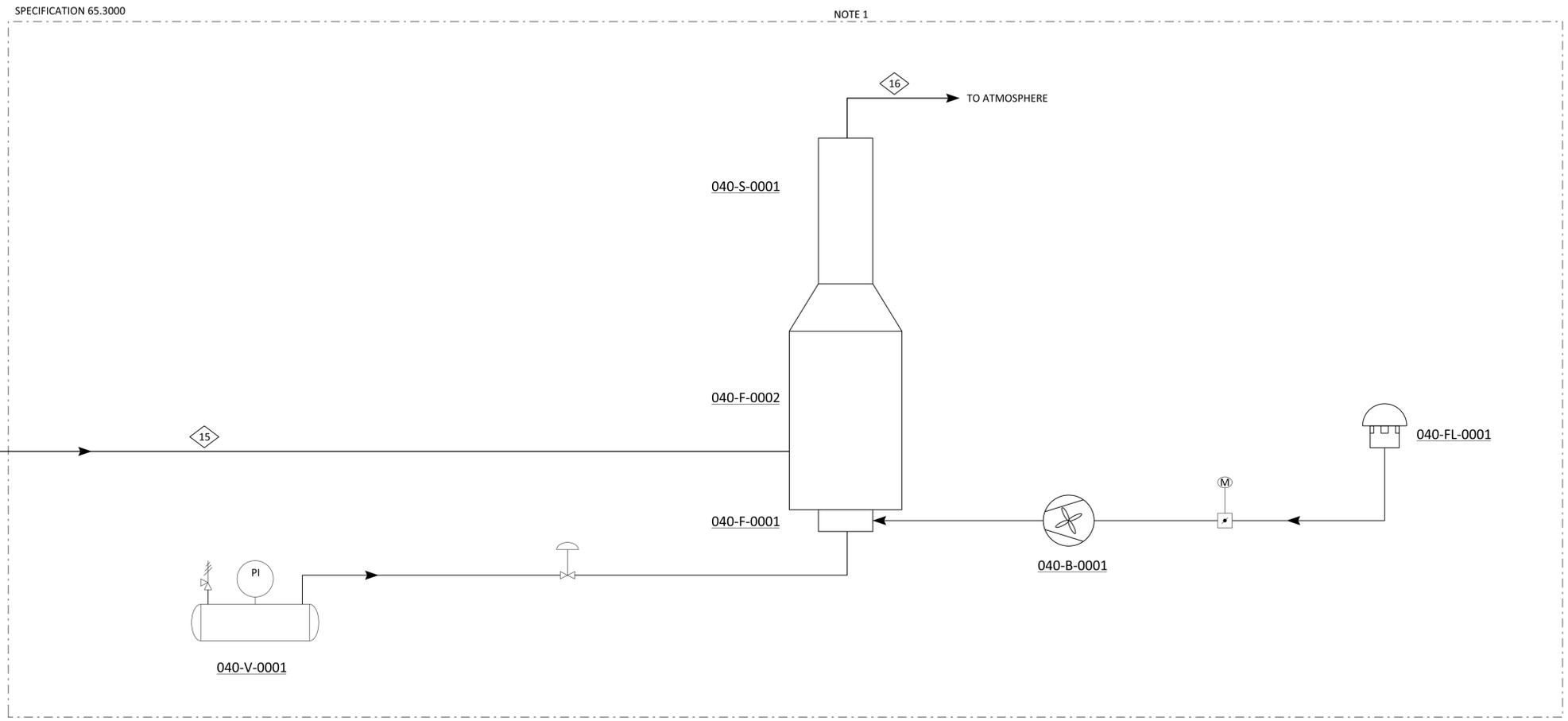
PACIFIC GAS & ELECTRIC
 MONTEREY PARK TRACT GAS MICROGRID SUPPORT

PROCESS FLOW DIAGRAM
 DIGESTER GAS COMPRESSION

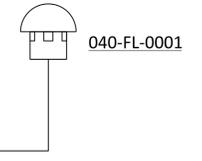
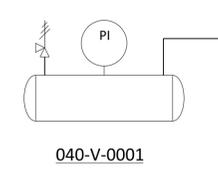
PROJECT	DRAWING NUMBER	REV
401616-0300-P1000		C
CODE	AREA	

040-V-0001 PROPANE STORAGE 040-F-0001 FLARE BURNER 040-F-0002 FLARE 040-S-0001 STACK 040-B-0001 FLARE FAN 040-FL-0001 INLET AIR FILTER

NOTES:
1. FLARE PACKAGE CONTENTS TO BE CONFIRMED SUBJECT TO FINAL PROCUREMENT. CONTENTS TO BE COMPLIANT WITH APPLICABLE EMISSION LAWS



401616-0200-P1000 OFFGAS
401616-0200-P1000 BYPASS



LEGEND
— NEW
— EXISTING
◇ STREAM NUMBER

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B	4/23/2019	ISSUED FOR RFQ	RJB	ODH	MCH	MCH	JMC
A	4/10/2019	ISSUED FOR CLIENT REVIEW	RJB	ODH	MCH	MCH	JMC

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DESIGNER: ODH, DRAWN: RJB
CHECKED: MCH, DATE: _____

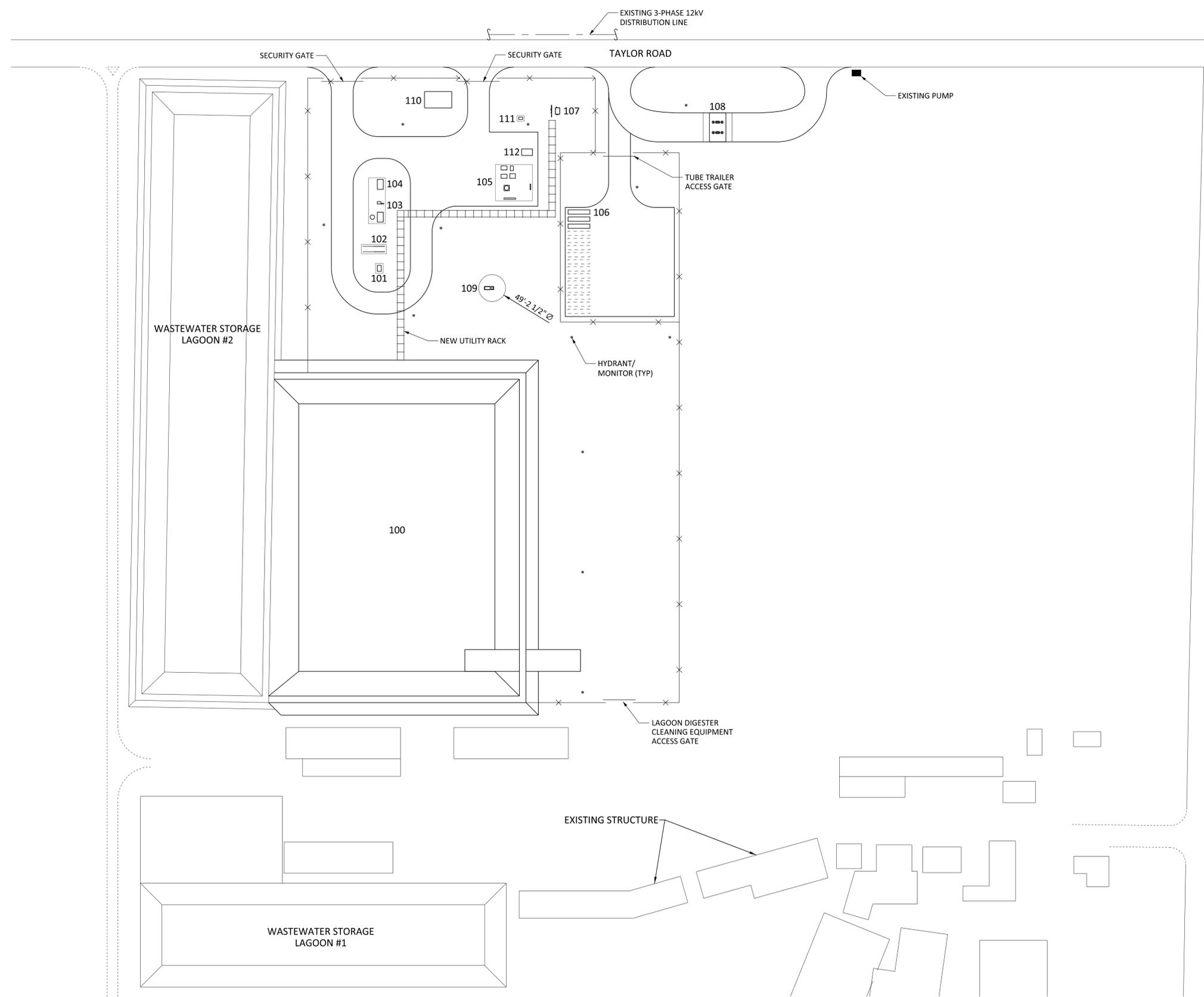
PACIFIC GAS & ELECTRIC
MONTEREY PARK TRACT GAS MICROGRID SUPPORT
PROCESS FLOW DIAGRAM
FLARE

PROJECT	DRAWING NUMBER	REV
401616-0400-P1000	401616-0400-P1000	C
CODE	AREA	

Appendix F. Equipment List

Area	Prefix	Train	Seq.	Tag	Equipment Name	Quantity	Type	Capacity/Duty	Size	Design		Materials of Construction	Supplier	Notes
										Pressure (psig)	Temperature (°F)			
Vessels & Filters														
010	FL	0	001	010-FL-0001	Solids Removal Screen	1	Horizontal						Existing	
020	FL	0	001	020-FL-0001	Digester Pretreatment Filter	1	Vertical	108.9 - 122.3 SCFM		200	90			
020	FL	0	002	020-FL-0002	H ₂ S Removal	1	Vertical	108.9 - 122.3 SCFM	8' x 17' (L x H)	200	90			
020	FL	0	003	020-FL-0003	Membrane Gas Separation	1	Vertical	108.9 - 122.3 SCFM	18' x 11' W x 12' H (L x W x H)	200	90			
030	V	0	001	030-V-0001A/B/C	Tube Trailer	3	Horizontal	363,148 SCF	40' x 8' x 8' (L x W x H)	3,600	90		By PG&E	
030	V	0	003	030-V-0003A/B/C	Dispenser Storage Vessel	3	Horizontal	11,571 SCF	23' x 20" (L x D)	3,600	90			
040	V	0	001	040-V-0001	Propane Storage	1	Horizontal							
040	FL	0	001	040-FL-0001	Inlet Air Filter	1	Vertical							
010	TK	0	001	010-TK-0001	Lagoon Accumulation Tank	1	Below Grade	15,000 GAL	120"x25.5' (DIAxL)	25	0			
Fired & Reactor Equipment														
010	R	0	001	010-R-0001	Lagoon Digester Plus Liner	1	Anaerobic Digester	2,750,514 ft ³	580' x 450' (L x W)	2" w.c	113			
010	R	0	002	010-R-0002	Lagoon Digester Cover	1	Anaerobic Digester		580' x 450' (L x W)	2" w.c	113			
040	F	0	001	040-F-0001	Flare Burner	1	Burner	108.9 - 122.3 SCFM			1832			
040	F	0	002	040-F-0002	Flare	1	Ground	108.9 - 122.3 SCFM	6' x 8' x 26'		1832			
Heat Exchangers														
020	E	0	001	020-E-0001	Digester Gas LP After-cooler	1	Shell & Tube	84,148 BTU/hr	Shell ID = 5.42" Area = 18.1 ft ²	Shell: 150 Tube: 200	Shell: 150 Tube: 510			Gas Side Flow Rate = 108.9 - 122.3 SCFM
030	E	0	001	030-E-0001	RNG After-cooler	1	Air-Cooled	62,000 BTU/hr	25 HP					Gas Side Flow Rate = 75.2 - 80.2 SCFM
Rotating Equipment														
010	P	0	001	010-P-0001	Washdown Sump Pump	1							Existing	
010	P	0	002	010-P-0002	Wastewater Transfer Pump	1		600 GPM					Existing	
010	P	0	003	010-P-0003	Wastewater Recycle Pump	1		600 GPM					Existing	
010	P	0	005	010-P-0005	Wastewater Irrigation Pump	1		600 GPM					Existing	
010	P	0	004	010-P-0004A/B	Rain Water Sump Pump	2	Centrifugal	170 GPM	6 HP	150	120			
020	P	0	001	020-P-0001A/B	Fire Water Pump	2	Centrifugal	2400 GPM	100 HP	150	120			
020	C	0	001	020-C-0001	Digester Gas Feed Compressor	1	Centrifugal	108.9 - 122.3 SCFM	31 HP	Inlet: 2" w.c Outlet: 200 psig	510			
030	C	0	001	030-C-0001	RNG Gas Compressor	1	Centrifugal	75.2 - 80.2 SCFM	60 HP	Inlet: 200 psig Outlet: 3600 psig	550			
020	B	0	001	020-B-0001	Digester Gas Blower	1	Centrifugal	108.9 - 122.3 SCFM	4.6 HP	Inlet: 2" w.c Outlet: 10 psig				
040	B	0	001	040-B-0001	Flare Fan	1			11 kW					
Packaged Equipment & Miscellaneous														
010	SU	0	001	010-SU-0001	Washdown Sump	1							Existing	
010	U	0	001	010-U-0001	Wastewater Storage Lagoon #1	1		900,973 ft ³	640' x 175' x 12'				Existing	
010	U	0	002	010-U-0002	Wastewater Storage Lagoon #2	1		2,028,492 ft ³	1075' x 215' x 13'				Existing	
020	U	0	001	020-U-0001	Dryer	1		108.9 - 122.3 SCFM		200	90			
030	U	0	001	030-U-0001	Point of Receipt and Odorization	1				200	90			
030	U	0	002	030-U-0002	Priority Panel	1				3,600	90			
030	U	0	003	030-U-0003	High/Lo PSI Regulation & Heat Exchange	1							By PG&E	
030	U	0	004	030-U-0004	MPT Interconnect to Distribution Pipeline	1							By PG&E	
030	PK	0	001	030-PK-0001A/B	RNG Dispenser	2	CNG	up to 5,000 SCFM	48" x 93" x 29" (WxHxD)	3,600	90			m. = 35 lbm/hr @ 3600 psig
040	S	0	001	040-S-0001	Stack	1	Stack							
030	U	0	002	030-U-0002	Dispenser Canopy	1	Canopy		53' x 53' x 20' (W x L x H)					

Appendix G. General Arrangement Drawing

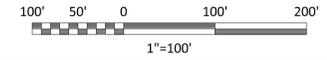


EQUIPMENT LIST UNIT #	EQUIPMENT #	DESCRIPTION
100	010-R-0001	LAGOON DIGESTER
	010-R-0002	LAGOON DIGESTER COVER
101	020-C-0001	DIGESTER GAS FEED COMPRESSOR
102	020-E-0001	DIGESTER GAS AFTER-COOLER
103	020-FL-0001	DIGESTER GAS CARBON FILTER
	020-FL-0002	H2S REMOVAL DRYER
104	020-FL-0003	MEMBRANE GAS SEPARATION
105	030-U-0001	POINT OF RECEIPT AND ODORIZATION
	030-C-0001	RNG COMPRESSOR
	030-E-0001	DIGESTER GAS AFTER-COOLER
	030-U-0002	PRIORITY PANEL
	030-V-0003A/B/C	RNG DISPENSER STORAGE TANK A/B/C
106	030-V-0001A/B/C	TUBE TRAILERS
107	030-U-0003	HIGH/LO PSI REG. & HEAT EXCHANGE
	030-U-0004	MONTEREY PARK TRACT INTERCONNECT TO DISTRIBUTION PIPELINE
108	030-PK-0001A/B	RNG DISPENSER A/B
	030-U-0002	DISPENSER CANOPY
109	040-F-0002	FLARE
110	020-P-0001A/B	FIRE PUMP A/B
111	030-XF-0001	MAIN PADMOUNT TRANSFORMER
112	030-BD-0001	ELECTRICAL PDC

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SITE LAYOUT
 SCALE: 1" = 100'



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B	4/23/2019	ISSUED FOR RFQ	RJB	RJB			MCH
A	4/19/2019	ISSUED FOR CLIENT REVIEW	RJB	RJB			MCH

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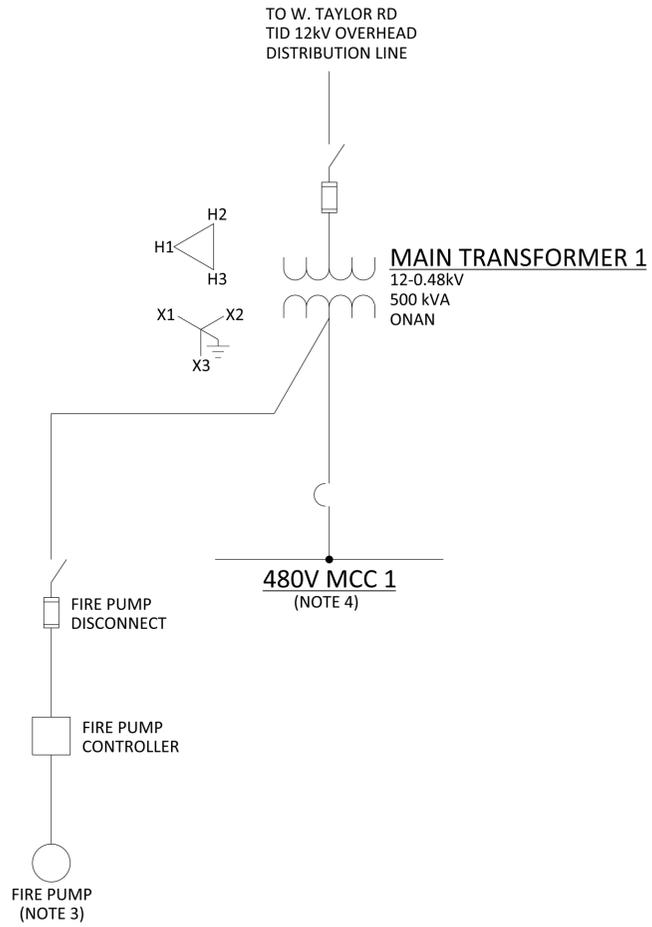
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PACIFIC GAS & ELECTRIC
 MONTEREY PARK TRACT GAS MICROGRID SUPPORT
 GENERAL ARRANGEMENT
 OVERALL SITE LAYOUT

PROJECT	DRAWING NUMBER	REV
401616-0000-G2000	401616-0000-G2000	C
CODE	AREA	

Appendix H. One-Line Diagram

- NOTES:
1. THE EQUIPMENT RATINGS AND CONFIGURATION SHOWN ARE PRELIMINARY AND SUBJECT TO CHANGE DURING DETAILED DESIGN.
 2. EXISTING DAIRY FARM LOADS ARE NOT SHOWN ON THIS ONE-LINE. REFER TO PROJECT EQUIPMENT LIST.
 3. SITE INCLUDES 1-100% DIESEL DRIVEN FIRE PUMP AND 1-100% ELECTRICAL MOTOR DRIVEN FIRE PUMP.
 4. 480V MOTOR CONTROL CENTER FEEDS PLANT ELECTRICAL LOADS INCLUDING PUMPS, LIGHTING, HVAC, ETC. REFER TO PROJECT LOAD LISTING FOR FURTHER DETAILS.



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B	05/08/19	ISSUED FOR FINAL REPORT	DCT	JSL		JSL	
A	04/25/19	ISSUED FOR CLIENT REVIEW	ALC	JSL		JSL	

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CHECKED		DATE	

PACIFIC GAS & ELECTRIC
 MONTEREY PARK TRACT GAS MICROGRID SUPPORT
 CONCEPTUAL OVERALL ONE-LINE DIAGRAM

PROJECT	DRAWING NUMBER	REV
401616-1000-E1000		B
CODE	AREA	

Appendix I. Permitting Matrix

Table I-1 Specific Environmental Permitting Requirements

AGENCY	PERMIT/ APPROVAL	REGULATED ACTIVITY	REQUIRED PROJECT PHASE	REQUIRED FOR PROJECT	EXPECTED/ TYPICAL REVIEW TIME	COMMENTS
<i>FEDERAL</i>						
EPA	SPCC Plan	Temporary onsite fuel and/or oil storage	Construction/ Operation	Yes	N/A	Construction contractor will be required to generate a SPCC Plan for construction activities. Once operation begins, the SPCC Plan will need to be updated or redrafted to reflect operating details for the facility.
EPA	TRI Reporting under EPCRA	Release of toxic emissions	Construction/ Operation	Likely	N/A	Reporting requirements triggered by storage/handling of toxic chemicals (EPCRA Section 313) above threshold limits.
EPA	TIER II Reporting under EPCRA	Toxic and hazardous chemical use and storage	Construction/ Operation	Likely	N/A	Identify whether storage of toxic chemicals will be required for construction and operation. Methane may trigger reporting.
<i>STATE</i>						
Lead Agency- Stanislaus County	CEQA Review	Land use and development in the state of California	Construction	Yes	6-18 months	If the project may cause either a direct or indirect impact to the environment and would require the issuance of a permit by one or more public agency, it will be considered a "project" under CEQA and will be subject to review
CEPA – Central Valley Water Resources Control Board	NPDES General Storm Water Construction Permit	Discharge of storm water from construction sites impacting one or more acres	Construction	Yes	2-3 months	Triggered by disturbance of one or more acres during construction Coverage available under Construction General Permit Order 2009-0009-DWQ. This permit will be obtained from the appropriate Regional Water Board.
CEPA – Central Valley Water Resources Control Board	Waste Discharge Requirements General Order for Dairy Farms with manure Anaerobic Digesters or Co-Digester Facilities	Waste water discharges from operations.	Operation	Yes	6-12 months	This permit is required for dairy farm facilities with manure anaerobic digesters or co-digesters that discharge waste water.
CEPA – Central Valley Water Resources Control Board	Water Use Permit/ Approval	Extraction and use of water	Operation	Possible	6-12 months	The type of permit or approval will depend on the final design of the facility and water source. Once those decisions are made, Black & Veatch can assist in determining what agency needs to issue the appropriate approval/permit.
CalTrans	Transportation/ Heavy Haul Permits	Transportation of oversized or overweight loads along state highways	Construction	Likely	2-3 months	May be required, depending on shipping methods used by the project
CDRRR	Solid Waste Facilities Permit	Constructing a new anaerobic digester	Construction	Possible	3-6 months	Although the CDRRR is responsible for approving permits, each permit is processed and issued by a Local Enforcement Agency (LEA). The LEA is the primary contact for the regulation of solid waste handling, processing or disposal activities, including permitting requirements. To determine whether a permit is required for any proposed facility, each potential operator should contact the appropriate county LEA and work with them directly regarding the applicability of regulatory requirements.

AGENCY	PERMIT/ APPROVAL	REGULATED ACTIVITY	REQUIRED PROJECT PHASE	REQUIRED FOR PROJECT	EXPECTED/ TYPICAL REVIEW TIME	COMMENTS
Air Requirements – San Joaquin Valley Air Pollution Control District (SJVAPCD)						
SJVAPCD	Authority to Construct (ATC)	Construction of Air Contaminant Sources	Pre - Construction	Yes	Likely 3-6 months if not held up by CEQA review. Review period may exceed this timeline if the project triggers major source permitting.	<p>An ATC will be required for each new emission source prior to construction. It is likely that the digester equipment, biogas conditioning equipment, and RNG refueling equipment will be treated as a facility separate from the existing dairy farm (i.e. permitted as a separate facility) due to the processes falling under different Standard Industrial Classification (SIC) codes.</p> <p>BACT required for any source that causes an increase in emissions of an air contaminant greater than 2 lb/day.</p> <p>New Source Review (NSR) major source permitting is triggered for projects emitting NO_x and VOCs in excess of 10 tons per year (tpy), CO in excess of 100 tpy, PM10, PM2.5 and SO_x in excess of 70 tpy which may result in more stringent emission limit requirements and lengthier permit processing time.</p> <p>The potential emissions from the new equipment would need to exceed 10 tpy for NO_x /VOCs, 27.38 tpy for SO_x, 14.6 tpy for PM10 & 100 tpy for CO to trigger the requirement to obtain offsets. Emergency equipment used exclusively as emergency standby equipment that does not operate more than 200 hours per year may be exempt from obtaining emissions offsets.</p> <p>An ambient air quality analysis including air dispersion modeling required for installation of any new emissions source. This analysis will be conducted by the Technical Services Division of the SJVAPCD.</p> <p>Toxics BACT is required if the cancer risk exceeds one in one million. The project may be required to undergo a Health Risk Assessment formed by the Technical Services Division of the SJVAPCD.</p>
SJVAPCD	Permit to Operate (PTO)	Operation of Air Contaminant Sources	Operation	Yes	<p>Agency drafts and issues permit for facilities below Title V thresholds upon verification Project was constructed according to parameters of ATC (separate application for PTO not required in this case).</p> <p>If triggered, initial Title V permit application due within 12 months of initial operation.</p>	<p>A PTO will be required for each new emission source.</p> <p>All PTOs required to be renewed every five years.</p> <p>Title V Permit to Operate required for Major Sources (i.e. sources with a PTE in excess of 10 tpy for NO_x & VOCs, 100 tpy for CO & PM2.5, 70 tpy for PM10 & SO_x and/or emissions of a single hazardous air pollutant (HAP) > 10 tpy, and/or cumulative HAPs emissions > 25 tpy).</p>
LOCAL						
Stanislaus County Planning Department	Conditional Use Permit	Required in some counties for a change in zoning to allow for construction of digester or gasifier	Construction	Yes	6-9 months	A Conditional Use Permit will be required by Stanislaus County for the RNG production and distribution facility. The issuance of a Conditional Use Permit includes a CEQA Review. A modification to the existing Use Permit may be obtained with further consultation with Stanislaus County once final design and operation parameters are established.

AGENCY	PERMIT/ APPROVAL	REGULATED ACTIVITY	REQUIRED PROJECT PHASE	REQUIRED FOR PROJECT	EXPECTED/ TYPICAL REVIEW TIME	COMMENTS
Stanislaus County Public Works Department	Building Permit	New construction	Construction	Yes	1-2 months	Will depend on final site location. This permit is representative of the majority of the US
Stanislaus County Public Works Department	Encroachment Permit	Construction activities and new connections to county roads	Construction	Possible	1-2 months	Will depend on final site location. This permit is representative of the majority of the US
Stanislaus County Planning Department	Grading Permit	Grading or clearing activities	Construction	Possible	1-2 months	Will depend on final site location. This permit is representative of the majority of the US
Fire Marshall	Fire Code Permit	Compliance with fire code	Construction	Yes	1-2 months	Will depend on final site location. This permit is representative of the majority of the US

Appendix J. Vendor Request for Quotation Packages

01100 - Technical Scope and Performance Requirements

01100.1 Technical Scope of Work

The work under these specifications shall include furnishing the following:

Black & Veatch is assisting with the design and development of a renewable natural gas (RNG) Production and Distribution Facility. The following stream numbers refer to the process streams shown in the attached mass balance. The new covered lagoon digester will receive a flushed manure stream from dairy cows (stream 7) and anaerobically digest the manure to produce biogas (stream 12). Biogas will be captured and cleaned to RNG downstream by a separate scope of supply. The project site is located approximately eight miles south of Modesto in the town of Ceres, CA, which is in the San Joaquin Valley (SJV). The site has access via well maintained secondary roads. Major transportation links in the vicinity include California Route 99 to the east and California Route 33 / Interstate 5 to the west.

Site-Specific Design Criteria

Design Barometric Pressure:	14.66 psia [NOTE 1]
Elevation:	73 ft
Design Minimum Ambient Temperature:	20 °F [NOTE 1]
Design Maximum Ambient Temperature (dry bulb):	113.6 °F [NOTE 1]
Design Maximum Ambient Temperature (wet bulb):	79.3 °F [NOTE 1]
NOTES	
1. Based on ASHRAE HVAC design data for 724926 weather station.	

Refer to Article 01100.2.1 for attachments detailing the process information. The attachments include the following to identify required process inlet and outlet conditions: process flow diagrams of the systems, mass balances with the stream conditions of each process flow. The scope of this package shall begin at the influent to the digester (stream 7) and end at the captured digester gas to gas treatment (stream 12). The supplier's scope should account for condensate inflow to the digester (stream 14) and digestate outflow to an adjacent wastewater storage lagoon (WWSL) (stream 11). The supplier shall provide a complete engineered package that accepts the defined conditions outlined below. Rainfall onto the digester cover shall be designed to accumulate in the lagoon accumulation tank. The tank will be pumped out and the flow will be routed to an adjacent storage lagoon. The digester shall be designed with an access ramp to allow for heavy equipment to enter the digester for periodic maintenance.

Design Basis Parameters

Condition	Value
Total Liquid Volume (ft ³)	2,751,000
Hydraulic Retention Time (days)	55
Organic Loading rate (lb _m VS/1000 ft ³ -day)	10 – 10.5
Digester Length (ft)	580
Digester Width (ft)	450
Digester Depth (ft)	15
Freeboard (ft)	2
Side Slopes	3:1

Major Equipment Scope			
Item	Description	Tag Number(s)	Quantity
1.	Lagoon Digester Plus Liner	010-R-0001	1
2.	Lagoon Digester Cover	010-R-0002	1
3.	Lagoon Accumulation Tank	010-TK-0001	1
4.	Rainwater Sump Pump	010-P-0004A/B	2

Miscellaneous Materials Scope			
Item	Description	Supplier	Purchaser
1.	All nuts, bolts, gaskets, special fasteners, backing rings, and other accessories required for installation of components and furnished equipment.	X	
2.	All piping integral to equipment and skids.	X	
3.	All coupling guards, belt guards, and personnel safety items required for furnished equipment.	X	
4.	All connections on furnished equipment for interfacing to Purchaser-furnished piping and instruments.	X	
5.	All valves and instruments required for automatic control and monitoring of the furnished system (or for manual control and monitoring of the system).	X	
6.	All instrument, power, and control wiring and raceway integral to equipment, skids, or packages furnished. Junction boxes shall be furnished with terminal blocks and internal wiring to these terminal blocks for equipment requiring external connection. In general, motors shall be rated 460VAC. Any main auxiliary power feeds to equipment skids will utilize 480VAC as the source of power.	X	
7.	Electrical and control wiring to connect furnished equipment terminal points to the plant electrical and control systems.		X
8.	Motor controls and starters for furnished equipment (Other than motor operated valves).		X
9.	Motor starters for motor operated valves (integral to valve actuators)	X	
10.	Ground pads and lugs for furnished equipment, skids and structures (minimum of two per skid or structure).	X	
11.	Heat tracing and insulation for freeze protection of pipe and devices on furnished equipment.		X
12.	Spare parts.	X	

Miscellaneous Materials Scope			
Item	Description	Supplier	Purchaser
13.	One set of maintenance tools required for dismantling, maintenance, and overhaul of the equipment. The tools shall be shipped in separate, heavily constructed wooden boxes provided with hinged covers and padlock hasps.	X	
14.	The use of all special tools and hardware required for erection of the equipment, exclusive of the maintenance tools furnished. Erection tools shall remain the property of Supplier, and all shipping costs to and from the jobsite shall be at Supplier's expense.	X	
15.	One set of consumable materials required for erection, startup and testing.	X	
16.	Permanently attached identification tags for all equipment and devices	X	
17.	Shop applied coating including but not limited to finish paint on all shop fabricated equipment, ancillary skids, material, structures and ancillary skid systems.	X	
18.	Finish painting/coating	X	
19.	Touchup paint for field		X
20.	Solvents and cleaning materials.		X
21.	Lifting eyes and lugs for offloading and setting equipment.	X	
22.	Permanent foundations/tie-down pads		X
23.	Leveling blocks, soleplates, thrust blocks, matching blocks, and shims.		X
24.	Anchor bolts, soleplates, or other items required to be permanently cast into concrete.		X
25.	All other features as specified in this procurement package.	X	

Miscellaneous Engineering/Services Scope			
Item	Description	Supplier	Purchaser
1.	Design, fabrication, testing, packaging, and delivery of all equipment.	X	
2.	Shop drawing submittals.	X	
3.	Shop testing.	X	
4.	Shop material inspection and testing.	X	
5.	Calibration of all instrumentation furnished.	X	
6.	Field technical advisor service time (2 Weeks on-site, 5-8 hr days).	X	

Miscellaneous Engineering/Services Scope			
Item	Description	Supplier	Purchaser
7.	Training Manuals including detailed training objectives, equipment overview, major component and support system description, controls, principle of operation, and testing materials.		X
8.	Operating personnel for site inspection, startup and testing.		X
9.	Receiving, unloading, storing, and field erection of all equipment.		X

01100.2 Drawings and Technical Attachments

This article lists the drawings and other technical attachments that have been prepared for the work under these specifications.

01100.2.1 Engineer's Attachments

The following listed attachments shall be part of the Purchase Order.

Drawing No. or Other Designation	Rev. No.	Title
401616-0100-P1000	B	Anaerobic Digestion
N/A	B	PGE MPT Microgrid Mass Balance WINTER
N/A	B	PGE MPT Microgrid Mass Balance SUMMER
401616-0000-P0101	C	PG&E Equipment List
401616-0000-G2000	B	Overall Site Layout

01100 - Technical Scope and Performance Requirements

01100.1 Technical Scope of Work

The work under these specifications shall include furnishing the following:

Black & Veatch is assisting with the design and development of a renewable natural gas (RNG) Production and Distribution Facility. The following stream numbers refer to the process streams shown in the attached mass balance. The new biogas conditioning equipment includes all equipment from the raw biogas (stream 12) through the compressed, cleaned RNG (stream 17). All upstream equipment to produce biogas and all downstream equipment to dispense RNG are covered under separate scopes of supply. The project site is located approximately eight miles south of Modesto in the town of Ceres, CA, which is in the San Joaquin Valley (SJV). The site has access via well maintained secondary roads. Major transportation links in the vicinity include California Route 99 to the east and California Route 33 / Interstate 5 to the west.

Site-Specific Design Criteria

Design Barometric Pressure:	14.66 psia ^[NOTE 1]
Elevation:	73 ft
Design Minimum Ambient Temperature:	20 °F ^[NOTE 1]
Design Maximum Ambient Temperature (dry bulb):	113.6 °F ^[NOTE 1]
Design Maximum Ambient Temperature (wet bulb):	79.3 °F ^[NOTE 1]
NOTES	
1. Based on ASHRAE HVAC design data for 724926 weather station.	

Refer to Article 01100.2.1 for attachments detailing the process information. The attachments include the following to identify required process inlet and outlet conditions: process flow diagrams of the systems and a mass balance with the stream conditions of each process flow. The supplier shall provide a complete engineered package that accepts the defined inputs of stream 12 in Article 01100.2.1 and produces the output specification defined below (stream 17).

Design Basis Parameters

Condition	Value
Pressure _{inlet} (psig)	0
Pressure _{outlet} (psig)	3,600
Temperature (°F)	100
Biogas Inlet Flow (SCFM)	115 – 125
RNG Outlet Flow (SCFM)	75 – 80

The RNG specification is as follows that must be met by the biogas conditioning equipment is as follows:

RNG Specification

Constituent	Units	Value
Methane	Vol %	>95%
Oxygen	Vol %	≤0.1%
Nitrogen	Vol %	<3%
Carbon Dioxide	Vol %	≤1%
Total Sulfur	ppm _v	≤17
Hydrogen Sulfide	ppm _v	≤4
Water Vapor	lb/MMSCF	≤7
Siloxanes	mg/Nm ³	0.1

Major Equipment Scope			
Item	Description	Tag Number(s)	Quantity
1.	Digester Gas Feed Compressor	020-C-0001	1
2.	Digester Gas After Cooler	020-E-0001	1
3.	Digester Gas Flare Blower	020-B-0001	1
4.	Digester Gas Carbon Filter	020-FL-0001	1
5.	H ₂ S Removal	020-FL-0002	1
6.	Dryer	020-U-0001	1
7.	Membrane Gas Separation	020-FL-0003	1
8.	RNG Gas Compressor	030-C-0001	1
9.	RNG Gas After Cooler	030-E-0001	1
10.	Propane Storage (Flare Fuel Supply)	040-V-0001	1
11.	Flare Burner	040-F-0001	1
12.	Flare (Includes Staged Burn for Thermal Oxidation)	040-F-0002	1
13.	Stack	040-S-0001	1
14.	Flare Fan	040-B-0001	1
15.	Inlet Air Filter	040-FL-0001	1

Miscellaneous Materials Scope			
Item	Description	Supplier	Purchaser
1.	All nuts, bolts, gaskets, special fasteners, backing rings, and other accessories required for installation of components and furnished equipment.	X	
2.	All piping integral to equipment and skids.	X	
3.	All coupling guards, belt guards, and personnel safety items required for furnished equipment.	X	
4.	All connections on furnished equipment for interfacing to Purchaser-furnished piping and instruments.	X	
5.	All valves and instruments required for automatic control and monitoring of the furnished system (or for manual control and monitoring of the system).	X	

Miscellaneous Materials Scope			
Item	Description	Supplier	Purchaser
6.	All instrument, power, and control wiring and raceway integral to equipment, skids, or packages furnished. Junction boxes shall be furnished with terminal blocks and internal wiring to these terminal blocks for equipment requiring external connection. In general, motors shall be rated 460VAC. Any main auxiliary power feeds to equipment skids will utilize 480VAC as the source of power.	X	
7.	Electrical and control wiring to connect furnished equipment terminal points to the plant electrical and control systems.		X
8.	Motor controls and starters for furnished equipment (Other than motor operated valves).		X
9.	Motor starters for motor operated valves (integral to valve actuators)	X	
10.	Ground pads and lugs for furnished equipment, skids and structures (minimum of two per skid or structure).	X	
11.	Heat tracing and insulation for freeze protection of pipe and devices on furnished equipment.		X
12.	Spare parts.	X	
13.	One set of maintenance tools required for dismantling, maintenance, and overhaul of the equipment. The tools shall be shipped in separate, heavily constructed wooden boxes provided with hinged covers and padlock hasps.	X	
14.	The use of all special tools and hardware required for erection of the equipment, exclusive of the maintenance tools furnished. Erection tools shall remain the property of Supplier, and all shipping costs to and from the jobsite shall be at Supplier's expense.	X	
15.	One set of consumable materials required for erection, startup and testing.	X	
16.	Permanently attached identification tags for all equipment and devices	X	
17.	Shop applied coating including but not limited to finish paint on all shop fabricated equipment, ancillary skids, material, structures and ancillary skid systems.	X	
18.	Finish painting/coating	X	
19.	Touchup paint for field		X
20.	Solvents and cleaning materials.		X

Miscellaneous Materials Scope			
Item	Description	Supplier	Purchaser
21.	Lifting eyes and lugs for offloading and setting equipment.	X	
22.	Permanent foundations/tie-down pads		X
23.	Leveling blocks, soleplates, thrust blocks, matching blocks, and shims.		X
24.	Anchor bolts, soleplates, or other items required to be permanently cast into concrete.		X
25.	All other features as specified in this procurement package.	X	

Miscellaneous Engineering/Services Scope			
Item	Description	Supplier	Purchaser
1.	Design, fabrication, testing, packaging, and delivery of all equipment.	X	
2.	Shop drawing submittals.	X	
3.	Shop testing.	X	
4.	Shop material inspection and testing.	X	
5.	Calibration of all instrumentation furnished.	X	
6.	Field technical advisor service time (2 Weeks on-site, 5-8 hr days).	X	
7.	Training Manuals including detailed training objectives, equipment overview, major component and support system description, controls, principle of operation, and testing materials.		X
8.	Operating personnel for site inspection, startup and testing.		X
9.	Receiving, unloading, storing, and field erection of all equipment.		X

01100.2 Drawings and Technical Attachments

This article lists the drawings and other technical attachments that have been prepared for the work under these specifications.

01100.2.1 Engineer's Attachments

The following listed attachments shall be part of the Purchase Order.

Drawing No. or Other Designation	Rev. No.	Title
401616-0200-P1000	B	Digester Gas Treatment
401616-0300-P1000	B	Digester Gas Compression

401616-0400-P1000	B	Flare
N/A	B	PGE MPT Microgrid Mass Balance WINTER
N/A	B	PGE MPT Microgrid Mass Balance SUMMER
401616-0000-P0101	C	PG&E Equipment List
401616-0000-G2000	B	Overall Site Layout

01100 - Technical Scope and Performance Requirements

01100.1 Technical Scope of Work

The work under these specifications shall include furnishing the following:

Black & Veatch is assisting with the design and development of a renewable natural gas (RNG) Production and Distribution Facility. The following stream numbers refer to the process streams shown in the attached mass balance. The new RNG refueling facility will use a high-pressure compressor to increase the pressure to meet user specifications and distribute RNG for local vehicle refueling. All upstream equipment to produce and clean biogas to RNG specifications is covered under separate scopes of supply. The project site is located approximately eight miles south of Modesto in the town of Ceres, CA, which is in the San Joaquin Valley (SJV). The site has access via well maintained secondary roads. Major transportation links in the vicinity include California Route 99 to the east and California Route 33 / Interstate 5 to the west.

Site-Specific Design Criteria

Design Barometric Pressure:	14.66 psia [NOTE 1]
Elevation:	73 ft
Design Minimum Ambient Temperature:	20 °F [NOTE 1]
Design Maximum Ambient Temperature (dry bulb):	113.6 °F [NOTE 1]
Design Maximum Ambient Temperature (wet bulb):	79.3 °F [NOTE 1]
NOTES	
1. Based on ASHRAE HVAC design data for 724926 weather station.	

Refer to Article 01100.2.1 for attachments detailing the process information. The attachments include the following to identify required process inlet and outlet conditions: process flow diagrams of the systems, a mass balance with the stream conditions of each process flow. At the outlet of the compressor (stream 17), the stream flows through a shell and tube heat exchanger to be reduced to a temperature of <100 °F. Other's scope terminates at the point of receipt, downstream of the heat exchanger. The client, Pacific Gas & Electric (PG&E) is responsible for regulating flow to and dispensing equipment for the tube trailers and regulating flow to the RNG refueling dispenser storage vessel. Black & Veatch's scope then resumes at the dispenser storage vessel (stream 19), which operates as a storage vessel to provide compressed RNG to users via RNG dispensers at 3,600 psig. The supplier shall provide a complete engineered package that accepts the defined input stream and produces the output streams defined above. Inlet conditions to the equipment are as follows:

Design Basis Parameters

Condition	Value
Pressure (psig)	3,600
Temperature (°F)	<100
Flow (SCFM)	75 – 80

Major Equipment Scope

Item	Description	Tag Number(s)	Quantity
1.	Dispenser Storage Vessel	030-V-0003A/B/C	3
2.	RNG Dispenser	030-PK-0001A/B	2
3.	Dispenser Canopy	030-U-0002	1

Miscellaneous Materials Scope			
Item	Description	Supplier	Purchaser
1.	All nuts, bolts, gaskets, special fasteners, backing rings, and other accessories required for installation of components and furnished equipment.	X	
2.	All piping integral to equipment and skids.	X	
3.	All coupling guards, belt guards, and personnel safety items required for furnished equipment.	X	
4.	All connections on furnished equipment for interfacing to Purchaser-furnished piping and instruments.	X	
5.	All valves and instruments required for automatic control and monitoring of the furnished system (or for manual control and monitoring of the system).	X	
6.	All instrument, power, and control wiring and raceway integral to equipment, skids, or packages furnished. Junction boxes shall be furnished with terminal blocks and internal wiring to these terminal blocks for equipment requiring external connection. In general, motors shall be rated 460VAC. Any main auxiliary power feeds to equipment skids will utilize 480VAC as the source of power.	X	
7.	Electrical and control wiring to connect furnished equipment terminal points to the plant electrical and control systems.		X
8.	480VAC Motor controls and starters for furnished equipment.		X
9.	Ground pads and lugs for furnished equipment, skids and structures (minimum of two per skid or structure).	X	
10.	Heat tracing and insulation for freeze protection of pipe and devices on furnished equipment.	X	
11.	Spare parts.	X	
12.	One set of maintenance tools required for dismantling, maintenance, and overhaul of the equipment. The tools shall be shipped in separate, heavily constructed wooden boxes provided with hinged covers and padlock hasps.	X	
13.	The use of all special tools and hardware required for erection of the equipment, exclusive of the maintenance tools furnished. Erection tools shall remain the property of Supplier, and all shipping costs to and from the jobsite shall be at Supplier's expense.	X	

Miscellaneous Materials Scope			
Item	Description	Supplier	Purchaser
14.	One set of consumable materials required for erection, startup and testing.	X	
15.	Permanently attached identification tags for all equipment and devices	X	
16.	Shop applied coating including but not limited to finish paint on all shop fabricated equipment, ancillary skids, material, structures and ancillary skid systems.	X	
17.	Finish painting/coating	X	
18.	Touchup paint for field		X
19.	Solvents and cleaning materials.		X
20.	Lifting eyes and lugs for offloading and setting equipment.	X	
21.	Permanent foundations/tie-down pads		X
22.	Leveling blocks, soleplates, thrust blocks, matching blocks, and shims.		X
23.	Anchor bolts, soleplates, or other items required to be permanently cast into concrete.		X
24.	All other features as specified in this procurement package.	X	

Miscellaneous Engineering/Services Scope			
Item	Description	Supplier	Purchaser
1.	Design, fabrication, testing, packaging, and delivery of all equipment.	X	
2.	Shop drawing submittals.	X	
3.	Shop testing.	X	
4.	Shop material inspection and testing.	X	
5.	Calibration of all instrumentation furnished.	X	
6.	Field technical advisor service time (2 Weeks on-site, 5-8 hr days).	X	
7.	Training Manuals including detailed training objectives, equipment overview, major component and support system description, controls, principle of operation, and testing materials.		X
8.	Operating personnel for site inspection, startup and testing.		X
9.	Receiving, unloading, storing, and field erection of all equipment.		X

01100.2 Drawings and Technical Attachments

This article lists the drawings and other technical attachments that have been prepared for the work under these specifications.

01100.2.1 Engineer's Attachments

The following listed attachments shall be part of the Purchase Order.

Drawing No. or Other Designation	Rev. No.	Title
401616-0300-P100	B	Digester Gas Compression
N/A	B	PGE MPT Microgrid Mass Balance WINTER
N/A	B	PGE MPT Microgrid Mass Balance SUMMER
401616-0000-P0101	C	PG&E Equipment List
401616-0000-G2000	B	Overall Site Layout

Appendix K. Capital Cost Estimate

PG&E

MPT Gas Microgrid

ESTIMATE SUMMARY

Cost Type	Description	Labor Man Hrs	Wage Rate	Labor Cost	Material Cost	Subcontract Cost	Total Cost
01	Demolition		\$70.00			\$0	\$0
02	Site Work			\$0	\$835,000	\$835,000	\$835,000
03	Foundations & Concrete	320		\$22,000	\$73,000	\$80,000	\$175,000
04	Buildings			\$0	\$0	\$0	\$0
05	Steel	373		\$26,000	\$44,000	\$250,000	\$320,000
06	Process & Mechanical Equipment			\$0	See Breakout	\$300,000	\$300,000
06A	Lagoon Digester	976		\$68,000	\$2,211,000		\$2,279,000
06B	Biogas Cleaning	824		\$58,000	\$1,867,000		\$1,925,000
06C	CNG Refueling	369		\$26,000	\$836,000		\$862,000
07	Piping & Piping Specials	1,652		\$116,000	\$344,000	\$0	\$460,000
08	Electrical Equipment	Incl. Below		Incl. Below	\$390,000	\$0	\$390,000
09	Electrical Bulks	400		\$28,000	\$84,000	\$0	\$112,000
10	Instrument Equipment	Incl. Below		Incl. Below	\$0	\$0	\$0
11	Instrument Bulks	160		\$11,000	\$34,000	\$0	\$45,000
12	Insulation					\$39,000	\$39,000
13	Painting					\$23,000	\$23,000
	Productivity Adj. for CA	1,775		\$124,000			\$124,000
	Subtotal	6,848	\$70.00	\$479,000	\$5,883,000	\$1,527,000	\$7,889,000
81	CM & Startup Staff					\$420,000	\$420,000
84	S/C Indirects	100%	of Direct Labor Cost			\$479,000	\$479,000
91	Engineering					\$508,000	\$508,000
92	Contingency	5%	of Direct and Indirect Costs			\$465,000	\$465,000
	Project Total	6,849		\$479,000	\$5,883,000	\$3,399,000	\$9,761,000

PG&E

MPT Gas Microgrid

ESTIMATE SUMMARY

Cost Type	Description	Labor Man Hrs	Wage Rate	Labor Cost	Material Cost	Subcontract Cost	Total Cost
01	Demolition		\$60.00	\$0	\$0	\$0	\$0
02	Site Work			\$0	\$835,000	\$835,000	\$835,000
03	Foundations & Concrete	200		\$12,000	\$70,000	\$80,000	\$162,000
04	Buildings			\$0	\$0	\$0	\$0
05	Steel	0		\$0	\$250,000	\$250,000	\$250,000
06	Process & Mechanical Equipment			\$0	See Breakout	\$150,000	\$150,000
06A	Lagoon Digester	1,000		\$60,000	\$1,650,000	\$0	\$1,710,000
06B	Biogas Cleaning	500		\$30,000	\$1,470,000	\$0	\$1,500,000
06C	CNG Refueling	300		\$18,000	\$836,000	\$0	\$854,000
07	Piping & Piping Specials	500		\$30,000	\$100,000	\$0	\$130,000
08	Electrical Equipment	Incl. Below		Incl. Below	\$390,000	\$0	\$390,000
09	Electrical Bulks	200		\$12,000	\$47,000	\$0	\$59,000
10	Instrument Equipment	0		0	\$0	\$0	\$0
11	Instrument Bulks	0		\$0	\$0	\$0	\$0
12	Insulation					\$24,000	\$24,000
13	Painting					\$13,000	\$13,000
	Productivity Adj. for CA	500		\$30,000			\$30,000
	Subtotal	3,200	\$60.00	\$192,000	\$4,563,000	\$1,352,000	\$6,107,000
81	CM & Startup Staff					\$210,000	\$210,000
84	S/C Indirects	100%	of Direct Labor Cost			\$192,000	\$192,000
91	Engineering					\$700,000	\$700,000
92	Contingency	2%	of Direct and Indirect Costs				\$0
	Project Total	3,200		\$192,000	\$4,563,000	\$2,454,000	\$7,209,000

PACIFIC GAS AND ELECTRIC COMPANY
ATTACHMENT B
GNA INCENTIVES REPORT

MEMORANDUM

June 6, 2019

TO: David Lewis – Director, Wholesale Marketing & Business Development, Pacific Gas and Electric
FROM: Cliff Gladstein – President, Gladstein, Neandross & Associates
SUBJECT: Incentives Report for PG&E re: Monterey Park Tract Opportunity

Pacific Gas and Electric (PG&E) has asked Gladstein, Neandross & Associates (GNA) to provide a report that summarizes the financial resources, grant and other incentive programs that can be harnessed by public and private interests for the development of dairy digester projects and associated conditioning and interconnect infrastructure. These resources will be used to deliver dairy manure-derived renewable natural gas (RNG) to the Monterey Park Tract (MPT) Project. In addition, GNA has been asked to summarize resources for financial assistance that can be harnessed to support the purchase and deployment of natural gas vehicles that could consume surplus renewable gas that is not used by residential consumers.

In performing this project, GNA focused on the following areas:

- California and Federal grant and/or other programs (tax credits, tax deductions, tax exemptions, low interest loans, loan guarantees, etc.) that support the development of dairy digesters and related infrastructure, including infrastructure related to transportation fueling infrastructure and related CNG/RNG vehicle procurement.
- Discussions with developers responsible for the construction and operation of dairy digester projects to gather information useful for determining the most relevant funding and revenue opportunities.
- Other sources of non-energy value revenue that can support the CAPEX and/or OPEX of dairy digesters and related infrastructure (i.e. Low Carbon Fuel Standard (LCFS), Renewable Fuel Standard (RFS), Renewable Energy Credits (RECs), utility procurement requirements, etc.).

In summarizing this information, GNA focused, as applicable and available for each source of funding, providing the following data:

- o Identify remaining amounts available after awards already made,
- o Identify timing of future requests for proposals or known deadlines or sunset dates for programs or funds; and,
- o Identify contact information for active opportunities for funding

In the discussion of each these funding sources, GNA provided, to the extent possible, data on the total level of resources that are allocated to the individual program as well as the total amount of resources that remain unprogrammed at the time of the report.

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Digester Infrastructure Programs

The following incentive programs provide funding for capital costs and/or operational expenses related to the construction and installation of digester facilities as well as associated clean up and interconnection infrastructure.

Community-Scale and Commercial-Scale Advanced Biofuels Production Facilities

Program Description: Encourage the production of alternative and renewable transportation fuels that can significantly reduce greenhouse gas (GHG) emissions, displace petroleum fuel demand, and stimulate economic development.

Funding Agency: California Energy Commission

Eligible Applicants: Private and public entities

Program Timeframe: Expected to open Q4 2019

Total Available Funds: \$16,900,000

Maximum Incentive per Project: Commercial-scale projects (greater than 1,000,000 Diesel Gallon Equivalent [DGE]) are eligible for up to \$5,000,000. Community-scale projects (100,000 to 1,000,000 DGE) are eligible for up to \$3,000,000.

Eligible Costs: Facility pre-engineering and design; engineering plans and specifications; performance tests, material assessments and other technical studies to verify product or equipment operating characteristics, equipment integrity, market applications, and compliance with regulations, standards and/or protocols; building and facility construction, modifications, and/or operations; asset and/or equipment acquisition; feedstock development activities; verification of advanced biofuel attributes and characteristics, and data collection and modeling; enhancement of biofuel production technology; facility process efficiency improvements leading to reductions in GHG emissions; and process improvements to accommodate lower carbon intensity feedstock and fuel production.

Dairy Digester Research and Development Program

Program Description: Supports the implementation of dairy digesters to promote methane GHG emission reductions in the agriculture sector.

Funding Agency: California Department of Food and Agriculture

Eligible Applicants: Private and public entities

Program Timeframe: Expected to open Q1 2020

Total Available Funds: \$35,000,000

Maximum Incentive per Project: Up to 50% of the total project cost with a maximum grant award of \$3,000,000 per project.

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Eligible Costs: Capital costs associated with the infrastructure and support equipment for dairy digesters. Applicants can submit multiple grant applications; however, each grant application must represent an individual digester project at a unique project site.

Biomethane Interconnector Monetary Incentive Program

Program Description: Pursuant to CPUC Decision 15-06-029 (2015) and subsequently modified by AB 2313 (2016), this program encourages the development of biomethane projects that are interconnected to the utilities' gas pipeline systems. The program will provide 50% of the interconnection costs up to a maximum of \$3 million per project and up to \$5 million for the pipeline interconnect for a cluster of three (3) or more dairy digesters.

Funding Agency: California Public Utilities Commission

Eligible Appliances: Public or private entities

Program Timeframe: As currently crafted, the monetary incentive is available to eligible Biomethane Interconnectors until December 31, 2021, or until the program has exhausted its \$40 million cap. SB 457 (Hueso), currently being considered by the California Legislature, would extend the deadline for the program to December 31, 2026.

Total Available Funds: \$40,000,000.

Maximum Incentive per Project: 50% of total interconnection cost to a maximum of \$3,000,000 for non-dairy biomethane projects and 50% of total interconnection cost to a maximum of \$5,000,000 for dairy cluster digester projects (three or more dairies).

Eligible Costs: All costs associated with the construction and commissioning of the interconnection between the biomethane producer and the utility gas pipeline.

Demonstration-Scale Advanced Biofuels Production Facilities

Program Description: Encourages the production of alternative and renewable transportation fuels that can significantly reduce GHG emissions, displace petroleum fuel demand, and stimulate economic development.

Funding Agency: California Energy Commission

Eligible Applicants: Private and public entities

Program Timeframe: Expected to open Q4 2019

Total Available Funds: \$6,000,000

Maximum Incentive per Project: 75% per project or \$3,000,000, whichever is less

Eligible Costs: Facility pre-engineering and design; engineering plans and specifications; performance tests, material assessments and other technical studies to verify product or equipment operating characteristics, equipment integrity, market applications, and compliance with regulations, standards and/or protocols; building and facility construction, modifications, and/or operations; asset and/or equipment acquisition; feedstock development activities;

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verification of advanced biofuel attributes and characteristics, and data collection and modeling; enhancement of biofuel production technology; facility process efficiency improvements leading to reductions in GHG emissions; and process improvements to accommodate lower carbon intensity feedstock and fuel production.

FY19 Bioenergy Technologies Office Multi-Topic Funding Opportunity Announcement (AOI 9: Rethinking Anaerobic Digestion)

Program Description: Demonstration of wet waste to biogas digestion at a less than 5 dry tons/day scale. Demonstrate processes with reduced disposal costs or diversion requirements.

Funding Agency: U.S. Department of Energy

Eligible Applicants: Public and commercial entities

Program Timeframe: Concept Papers due June 3, 2019. Similar funding opportunities are expected to open Q3 2020.

Total Available Funds: \$5,000,000

Maximum Incentive per Project: \$3,000,000

Eligible Costs: Project equipment and labor with at least 20% required cost share.

Modified Accelerated Cost-Recovery System (MACRS)

Program Description: Under the federal Modified Accelerated Cost-Recovery System (MACRS), businesses may recover investments in certain property through depreciation deductions.

Funding Agency: U.S. Internal Revenue Service

Eligible Applicants: Businesses

Program Timeframe: Involvement in the program filed as part of annual tax filings. Benefit generated over a 3- to 5-year depreciation.

Total Available Funds: Not applicable

Maximum Incentive per Project: Not applicable

Eligible Costs: Capital cost depreciation. Bonus Depreciation has been sporadically available at different levels during different years. Most recently, The Tax Cuts and Jobs Act of 2017 increased bonus depreciation to 100% for qualified property acquired and placed in service after September 27, 2017 and before January 1, 2023

Rural Energy for America Program (REAP)

Program Description: Provide financial assistance to agricultural producers and rural small businesses in America to purchase, install, and construct renewable energy systems, make energy efficiency improvements to non-residential buildings and facilities, use renewable technologies that reduce energy consumption, and participate in energy audits and renewable energy development assistance.

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Funding Agency: U.S. Department of Agriculture

Eligible Entities: Agricultural producers and rural small businesses

Program Timeframe: April 1 of each year for grants; Continuous application cycle for guaranteed loans

Total Available Funds: \$600,000,000 for the current fiscal year

Maximum Incentive per Project: Grants of 25% of project costs up to \$500,000 and up to \$25 million loan guarantee

Eligible Costs: System, assessment, permitting, licensing fees, and business plan expenses with at least 25% required cost share.

Alternative Fuel Vehicle and Refueling Infrastructure Programs

Critical to the financial success of dairy digester projects is the ability to sell surplus gas to the transportation sector, where the gas has the highest monetary value. Thus, programs that increase demand for RNG in transportation indirectly support the development of dairy digesters. The following incentive programs provide funding for the purchase and deployment of low and near zero emission vehicles that could be end users of dairy RNG.

Advanced Freight and Fleet Technologies Program

Program Description: Expected to support zero emission vehicle and infrastructure research, development, and demonstration projects to accelerate clean transportation adoption at larger scales. Based on recent intelligence gathered from the Energy Commission, GNA expects that the program will fund electric and hydrogen recharging/refueling stations and connected vehicle technologies. Thus, this opportunity would be tangential to the Monterey Park Tract effort in that RNG could be used to generate electricity for a EV charging station or to HFC for a hydrogen fueling station.

Funding Agency: California Energy Commission

Eligible Applicants: Private and public entities

Program Timeframe: Expected to open Q3 2019

Total Available Funds: \$17,500,000

Maximum Incentive per Project: Under development, but likely to be \$3,000,000 to \$5,000,000 per project

Eligible Costs: Under development; likely to include charging infrastructure deployment

California VW Program for Combustion Freight and Marine

Program Description: Maximize NOx reductions by funding the most cost-effective, lowest emission Class 7 and 8 vehicles equipped with ultra-low NOx (0.02 g/bhp-hr) engines.

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Funding Agency: California Air Resources Board (CARB) and administered by the South Coast Air Quality Management District (SCAQMD); though the program is administered by SCAQMD, fleets within the SJVAPCD as well as the rest of the state will be eligible to apply.

Eligible Applicants: Private and public entities

Program Timeframe: Expected to open Q3 2019

Total Available Funds: \$30,000,000

Maximum Incentive per Project: No maximum established

Eligible Costs: Vehicle replacement and/or repower costs are eligible. Applicants may secure \$35,000 to \$85,000 per ultra-low NOx vehicle, depending on size, ownership, and project type.

Clean School Bus Rebate Program

Program Description: Replace school buses powered by model year 2006 or older engines with new conventional and alternative fuel vehicles to reduce diesel emissions.

Funding Agency: U.S. Environmental Protection Agency

Eligible Applicants: Public and private school bus operators

Program Timeframe: Expected to open Q4 2019

Total Available Funds: Expected to be \$9,000,000, based on the last solicitation's funding levels

Maximum Incentive per Project: \$400,000 for fleets with more than 100 buses. \$200,000 for fleets with less than 100 buses

Eligible Costs: \$15,000 per Class 3-5 bus and \$20,000 per Class 6-8 bus

Drive Clean! Rebate Program

Program Description: Provide rebates to residents and businesses for the purchase of new, clean-air vehicles.

Funding Agency: San Joaquin Valley Air Pollution Control District (SJVAPCD)

Eligible Applicants: Private and public entities and individuals

Program Timeframe: Open now on a first-come, first-served basis

Total Available Funds: No maximum established

Maximum Incentive per Project: 25% of total vehicle cost up to \$3,000. There is no maximum per project level established.

Eligible Costs: Capital costs of purchasing a new vehicle

Goods Movement Emission Reduction Projects (Proposition 1B Program)

Program Description: Replace heavy duty diesel trucks with new alternative fuel equipment, install charging/fueling infrastructure, and/or install truck-stop electrification.

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Funding Agency: SJVAPCD

Eligible Applicants: Private and public entities

Program Timeframe: Expected to open Q3 2019

Total Available Funds: Under development

Maximum Incentive per Project: Up to \$100,000 per heavy-duty natural gas vehicle. There is no maximum per project level established.

Eligible Costs: Capital costs of purchasing a new vehicle and/or the equipment and installation costs for new charging/fueling infrastructure

Hybrid and Zero Emission Truck and Bus Voucher Incentive Project (HVIP) – Low NOx Incentives

Program Description: Encourage and accelerate the deployment of vehicles using engines that meet the optional low NOx standards in California and that use renewable fuels.

Funding Agency: CARB

Eligible Applicants: Private and public entities

Program Timeframe: Open now on a first-come, first-served basis

Total Available Funds: \$54,294,304 as of May 9, 2019

Maximum Incentive per Project: Up to \$45,000 per natural gas vehicle. Fleets are no longer limited to a set number of incentives (cap used to be set at 200 vehicles per applicant).

Eligible Costs: Capital costs of purchasing/leasing a new vehicle

National Clean Diesel Funding Assistance Program

Program Description: Reduce diesel emissions from fleets in poor air quality areas.

Funding Agency: U.S. Environmental Protection Agency

Eligible Applicants: Private and public entities

Program Timeframe: Expected to open Q3 2019

Total Available Funds: \$40,000,000 expected

Maximum Incentive per Project: \$1,000,000 to \$4,000,000, depending on the region of application.

Eligible Costs: Up to 45% of vehicle replacement costs. Up to 35% of the cost of a new drayage truck.

New CNG Infrastructure Program

Program Description: Reduce emissions through construction of new CNG fueling stations.

Funding Agency: SJVAPCD

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Eligible Applicants: Private and public entities

Program Timeframe: Expected to open Q3 2019

Total Available Funds: Under development

Maximum Incentive per Project: Under development

Eligible Costs: Capital costs associated with purchase and installation of refueling equipment

Public Benefit Grant Program – New Alternative Fuel Vehicle Purchase

Program Description: Funds the purchase of new alternative fuel vehicles for public agencies to promote clean air alternative-fuel technologies.

Funding Agency: SJVAPCD

Eligible Applicants: Public Entity

Program Timeframe: Open now on a first-come, first-served basis

Total Available Funds: \$8,000,000

Maximum Incentive per Project: \$100,000

Eligible Costs: Up to \$20,000 per vehicle

Targeted Air Shed Grant Program

Program Description: Support emission reduction planning and projects in the nation's top five non-attainment areas for levels of ozone and PM2.5 ambient air concentrations.

Funding Agency: U.S. Environmental Protection Agency

Eligible Applicants: Governments; Air pollution control agencies

Program Timeframe: Expected to open Q4 2019

Total Available Funds: \$40,000,000

Maximum Incentive per Project: \$5,000,000. However, the maximum amount that may be requested per application is \$3,000,000. Applicants may submit more than one application if they are for different projects and are submitted separately.

Eligible Costs: Capital costs associated with the purchase/lease of new vehicles and/or refueling infrastructure.

Truck Replacement Program

Program Description: Replace older diesel medium- and heavy-duty on road trucks with cleaner alternative fuel vehicles.

Funding Agency: SJVAPCD

Eligible Applicants: Private and public entities

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Program Timeframe: Open now on first-come, first-served basis

Total Available Funds: No maximum established

Maximum Incentive per Project: Natural Gas Truck: Up to \$100,000 per vehicle. There is no project maximum.

Eligible Costs: Costs of purchasing/leasing a new vehicle

Non-Energy Value Revenue Incentive Programs

The following monetary incentives increase the value of the dairy RNG if that gas is used as a fuel in a motor vehicle (LCFS, RFS) or the RNG is used to produce renewable electricity. The revenue for these non-energy revenue streams significantly improves the economics of dairy digester development, and is a substantial incentive for expansion of this industry.

Low Carbon Fuel Standard

Program Description: A regulatory standard for the carbon content of motor vehicle fuels for sale in California. All fuel providers must either reduce the carbon content of the motor vehicle fuels that they sell in CA or purchase credits from those who either exceeded their requirement or produce alternative fuels with low carbon content. The LCFS to reduce the carbon intensity (CI) of transportation fuels by 7.5% by 2020 and by 20% by 2030.

Administering Agency: CARB

Eligible Participants: The carbon market will include Credit Generators and Credit Purchasers. Credit Generators include producers and importers of low carbon fuels (i.e. dairy digesters), zero-emission vehicle infrastructure owners, and operators of projects that have been verified for their emission-reducing actions. Credit Purchasers include any regulated party (e.g., refiner or motor vehicle fuel retailer) that needs to meet emission reduction goals.

Program Timeframe: The program operates on an ongoing basis. Eligible participants submit energy consumption reports within 45 calendar days of the end of each quarter. CARB verifies the reports and issues credits within 90 days of the end of each quarter.

Total Available Funds: There is no maximum for the availability of funds. The market for LCFS credits has been very robust since the inception of the program, and credit value is dictated by the supply and demand of credits. In 2017 there were 35.8 million credits generated at a 2017-average credit price of \$89.14/credit (total market value of \$3.191 billion). In 2018, there were 47.1 million credits generated at a 2018 average credit price of \$160/credit (total market value of \$5.756 billion).

Maximum Incentive per Project: There is no defined maximum. Credits are stored or traded at a dollar amount established by the market, based on data reported to CARB. The value of a credit in California as of April 2019 was \$180/MT CO₂e.

Eligible Costs: Credits are based off of the reduction of a metric ton of carbon emissions.

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Renewable Fuel Standard

Program Description: A national policy created under the Energy Policy ACT of 2005 and was expanded and extended by the Energy Independence and Security Act of 2007 that sets a requirement for the amount of petroleum-based transportation fuels that must be replaced by renewable alternatives.

Administering Agency: EPA

Eligible Participants: Refiners and importers of gasoline and diesel sold in the U.S. as motor vehicle fuel must meet volumetric targets for renewable fuel content. These are also known as Obligated Parties, and they must purchase and blend renewable fuels in to their petroleum-based products made available for sale in the U.S. or buy credits from parties that produce renewable transportation fuels, such as dairy RNG. Renewable fuel exporters and producers generate renewable fuel credits, which are called Renewable Identification Numbers (RIN), and are also known as RIN Generators.

Program Timeframe: The program operates on an ongoing basis. RIN Generators enter into trade agreement with Obligated Parties. Each trading partners enters the EPA moderated transaction system (EMTS) to manage transactions. Obligated Parties typically retire RINs by March 31 of each year, but RINs that are not used may carry over into the following compliance year.

Total Available Funds: There is little in the way of reliable data regarding the annual value of the RIN market. RIN prices fluctuate daily, dependent on supply and demand, as well as market perceptions of the future of the RFS program. For 2019, the volume standard set forth in the Energy Independence and Security Act of 2007 (EISA) for all renewable fuels is 28 billion gallons.

Maximum Incentive per Project: There is no set maximum. RINs are only generated from qualifying feedstock and fuel pathways. As of May 2019, the values of D3 and D5 RINs are:

- D3 (biogas from landfills, wastewater, dairy digesters, and biomass): \$1.450 per gallon
- D5 (biogas from waste digesters): \$0.315 per gallon

Eligible Costs: Renewable identification numbers (RINs) are the currency of the Renewable Fuel Standard Programs (1 RIN = 1 gallon of renewable fuel = 77,000 BTU).

Renewable Energy Credits/Certificates

Program Description: Most U.S. states have requirements that a certain percentage of the electricity that is distributed by electric utilities must come from renewable sources. When a utility does not procure sufficient renewable electricity to meet their requirements, they have the option of purchasing Renewable Energy Credits (also known as Renewable Energy Certificates), or RECs, from a third party. A REC represents one megawatt hour (MWh) of electricity from a renewable source, which includes RNG-fueled generators in California and other states. The REC can be unbundled from the energy value and sold separately. RECs generated in California, for instance, can be sold in another state to a utility that needs the credit to meet their renewable portfolio obligation. Some states will require that the any RECs used for compliance purposes

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must be generated within the same North American Electric Reliability Corporation (NERC) region as the buyer.

In addition to states that have mandated a Renewable Portfolio Standard (RPS), where utilities must comply with the requirement to procure a certain percentage of renewable power, RECs can be purchased by parties that are voluntarily choosing to purchase renewable power. An example could be an environmentally conscious business or municipality whose local utility is not required to reduce their environmental footprint. Typically, the prices for “compliance” RECs will be significantly higher than for “voluntary” RECs.

Administering Agency: REC compliance will typically be administered by each state’s public agency responsible for governing electric utilities. Most states will conduct periodic audits of RECs using an accredited certification body, such as the Center for Resource Solutions.

Eligible Participants: On the production side, RECs can be created by any qualifying generator of renewable energy, which includes wind, solar, low-impact hydropower and certain types of biomass, of which dairy gas would likely qualify. On the consumption side, any utility with a RPS compliance requirement can participate, as well as any environmentally conscious party that seeks to purchase and retire the REC.

Program Timeframe: The program operates on an ongoing basis.

Total Available Funds: There is no cap on the total market value of RECs. REC prices vary widely from state to state and are heavily impacted if the buyer is a compliance or voluntary participant.

Maximum Incentive per Project: There is no consistent requirement from state to state that dictates the total portion of a utility’s RPS requirement that may be met through the purchase of RECs.

Eligible Costs: There are no known restrictions on what REC revenue can be used for.

Retail Prices of Renewable Natural Gas

As of this report, there is no additional value for RNG, whether from a dairy digester, a landfill or a wastewater treatment plant, as a fossil gas substitute unless a) the RNG is used as a vehicle fuel or b) the RNG is used to generate renewable electricity. No state, including California, has a renewable gas portfolio standard (the natural gas equivalent of an RPS). Thus, when RNG is used for residential, commercial or industrial applications as a substitute for fossil gas, the seller will only be able to charge the customer the same rate that they charge for fossil gas.

Once, however, the dairy RNG is used to fuel a motor vehicle or to generate renewable electricity, the price of the gas is bolstered by the value of its renewable and/or low carbon attributes. As discussed above, when used as a transportation fuel, particularly in California where the low-carbon attribute of the dairy RNG can be maximized, dairy RNG realizes its peak value. At current D Code 3 and LCFS credit prices,

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just the renewable and low carbon attributes of the fuel are worth \$94/MMBTU when it is used to fuel a motor vehicle.

When the RNG is used to generate renewable electricity, there may be some surplus value to the power if the REC that is generated can be sold to a utility with an RPS requirement. This value, however, is considerably less than that which can be generated from the use of the fuel in transportation. REC prices vary, but generally have been falling in recent years. In California, where most utilities have exceeded their RPS requirements, the price paid for RECs is low compared to other states where meeting the RPS requirement may face more challenges. In addition, as more states develop and implement requirements for solar generated electricity, the prices paid for biomass-generated RECs may be negatively impacted as the solar-RECs (SRECs) have more value in the marketplace.

It should be noted that, although California does have the Bioenergy Market Adjusting Tariff (BioMAT), MPT would not qualify for participation since they are situated in Turlock Irrigation District (TID) electric service territory, not in a California investor owned utility electric service territory.

Conclusion

There are a number of possible third-party funding sources that can be tapped to reduce the CAPEX and/or OPEX of dairy digesters. There will be substantial difference in these incentives depending on whether the gas that is generated by the digester is used for residential gas consumption, power generation, or as a vehicle fuel. Although there are a number of programs that will support the construction of the digester and associated clean up and interconnection infrastructure, additional grants can be obtained on top of these to support the purchase and deployment of motor vehicle end users for the dairy RNG.

When non-energy value attributes are assessed, it dramatically alters the revenue generating capability of the dairy digester project. As of this writing, by far the greatest value for dairy digester gas in California is as a vehicle fuel. However, no funding program requires all the gas that is produced from dairy effluent go to one source, so clearly a strategy that can be pursued is to size the system so that it can both provide for all of the needs of the Monterey Park Tract, but also produce surplus gas that can be sold to a transportation end user. This suggests that, particularly for ratepayers, a dual strategy should be employed to maximize the rate of return.

**PG&E Gas and Electric
Advice Submittal List
General Order 96-B, Section IV**

AT&T	Downey & Brand	Pioneer Community Energy
Albion Power Company	East Bay Community Energy	Praxair
Alcantar & Kahl LLP	Ellison Schneider & Harris LLP	Regulatory & Cogeneration Service, Inc.
	Energy Management Service	SCD Energy Solutions
Alta Power Group, LLC	Engineers and Scientists of California	
Anderson & Poole	Evaluation + Strategy for Social Innovation	SCE
	GenOn Energy, Inc.	SDG&E and SoCalGas
Atlas ReFuel	Goodin, MacBride, Squeri, Schlotz & Ritchie	
BART	Green Charge Networks	SPURR
	Green Power Institute	San Francisco Water Power and Sewer
Barkovich & Yap, Inc.	Hanna & Morton	Seattle City Light
P.C. CalCom Solar	ICF	Sempra Utilities
California Cotton Ginners & Growers Assn	International Power Technology	Southern California Edison Company
California Energy Commission	Intestate Gas Services, Inc.	Southern California Gas Company
California Public Utilities Commission	Kelly Group	Spark Energy
California State Association of Counties	Ken Bohn Consulting	Sun Light & Power
Calpine	Keyes & Fox LLP	Sunshine Design
	Leviton Manufacturing Co., Inc. Linde	Tecogen, Inc.
Cameron-Daniel, P.C.	Los Angeles County Integrated Waste Management Task Force	TerraVerde Renewable Partners
Casner, Steve	Los Angeles Dept of Water & Power	Tiger Natural Gas, Inc.
Cenergy Power	MRW & Associates	
Center for Biological Diversity	Manatt Phelps Phillips	TransCanada
City of Palo Alto	Marin Energy Authority	Troutman Sanders LLP
	McKenzie & Associates	Utility Cost Management
City of San Jose	Modesto Irrigation District	Utility Power Solutions
Clean Power Research	Morgan Stanley	Utility Specialists
Coast Economic Consulting	NLine Energy, Inc.	
Commercial Energy	NRG Solar	Verizon
County of Tehama - Department of Public Works		Water and Energy Consulting
Crossborder Energy		Wellhead Electric Company
Crown Road Energy, LLC		Western Manufactured Housing Communities Association (WMA)
Davis Wright Tremaine LLP		Yep Energy
Day Carter Murphy		
	Office of Ratepayer Advocates	
Dept of General Services	OnGrid Solar	
Don Pickett & Associates, Inc.	Pacific Gas and Electric Company	
Douglass & Liddell	Peninsula Clean Energy	