

**QUALITY ASSURANCE/QUALITY CONTROL
(QA/QC) PLAN
FOR
GARDEAU CREST FARMS, LLC ANAEROBIC DIGESTER GAS
(ADG) SYSTEM
Agreement # 25354**

Second Draft

January 2013

Submitted to:

New York State Energy Research and Development Authority
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and

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Introduction

This plan describes the approach that will be used to monitor the performance of the anaerobic digester gas (ADG) system that is currently being installed at Gardeau Crest Farms, LLC, (“The Farm”) in Perry, NY, to produce biogas and electricity. Biogas will be used to fuel one engine-generator to produce power that will be consumed on site and/or exported back to the local utility. A monitoring system will be installed to measure and collect the data necessary to quantify the electric power produced and amount of biogas used by the engine-generator. The data will serve as the basis for payment of three (3) years of performance incentive payments, which The Farm has applied for under a Standard Performance Contract with NYSERDA based on a Total Contracted Capacity of 648 kW.

ADG System Description

The digester system at the farm was designed by DVO Anaerobic Digesters. The power plant equipment was provided by Martin Machinery while the gas conditioning equipment was supplied by DVO Anaerobic Digesters. Gas and power metering were provided by Gen-Tec and Sage Metering Inc. The site will operate one 648 kW synchronous engine-generator with gas conditioning equipment, piping and controls installed in a designated building next to the digester. All the electrical loads at the farm have been consolidated into a single 3-phase, 277/480 volt electrical service in order to accommodate the interconnection of the generator system. The electrical system includes controls to synchronize the generator to the grid as well as a protective relay and controls to automatically isolate the units from the utility grid in the event of a utility power outage. The generator is connected to the NYSEG distribution network through a two meter system - one outgoing and one incoming. A 648 kW, diesel generator is connected to the farm electrical system through a 1,200 A disconnect/transfer switch for use during power outages.



Engine-Generator Building



Digester

Figure 1 - Photos of System Components

Table 1 - Biogas Systems at Willet Dairy

Digester	DVO Anaerobic Digester mixed plug flow, concrete cover, heated
Feedstock	Dairy Manure, 2,000 animal equivalents
Engine	Guascor SFGLD 480 Engine 648 kW on biogas at 100% load
Generator	Stamford PI736B – 480 VAC, 3 Phase
Biogas Conditioning	Martin Machinery gas conditioning, a DVO hydrogen sulfide removal system.
Engine Backup/startup Fuel	None
Heat Recovery Use	Digester heating
Additional Heat Recovery	None



Figure 2 - Engine-Generator Room

Figure 3 schematically shows the biogas system and engine-generator. Figure 4 shows the process flow diagram while Figure 5 shows the single line electrical diagram for the system. Biogas from the digester is used in the engine-generator or flared. The biogas flare operates using a mechanically-actuated relief valve that vents biogas to maintain the digester static pressure requirements. Sage Prime metering devices measure gas flow to the flare (G1) and to the engine-generator (G2). Gas flow data from these meters is also shown on the Gen-Tec/Red Lion graphical display. Biogas for the engine is de-watered and pressurized via the gas conditioning equipment provided by DVO Anaerobic Digesters. Prior to the gas being sent to the gen-set, gas is first pressurized then cooled to drop out unnecessary moisture in the biogas. The gas is then re-heated for use in the engine. H₂S levels are reduced in the digester by the DVO H₂S reduction system.

Process Flow - Gas is black line from digester to engine and exhaust & flare

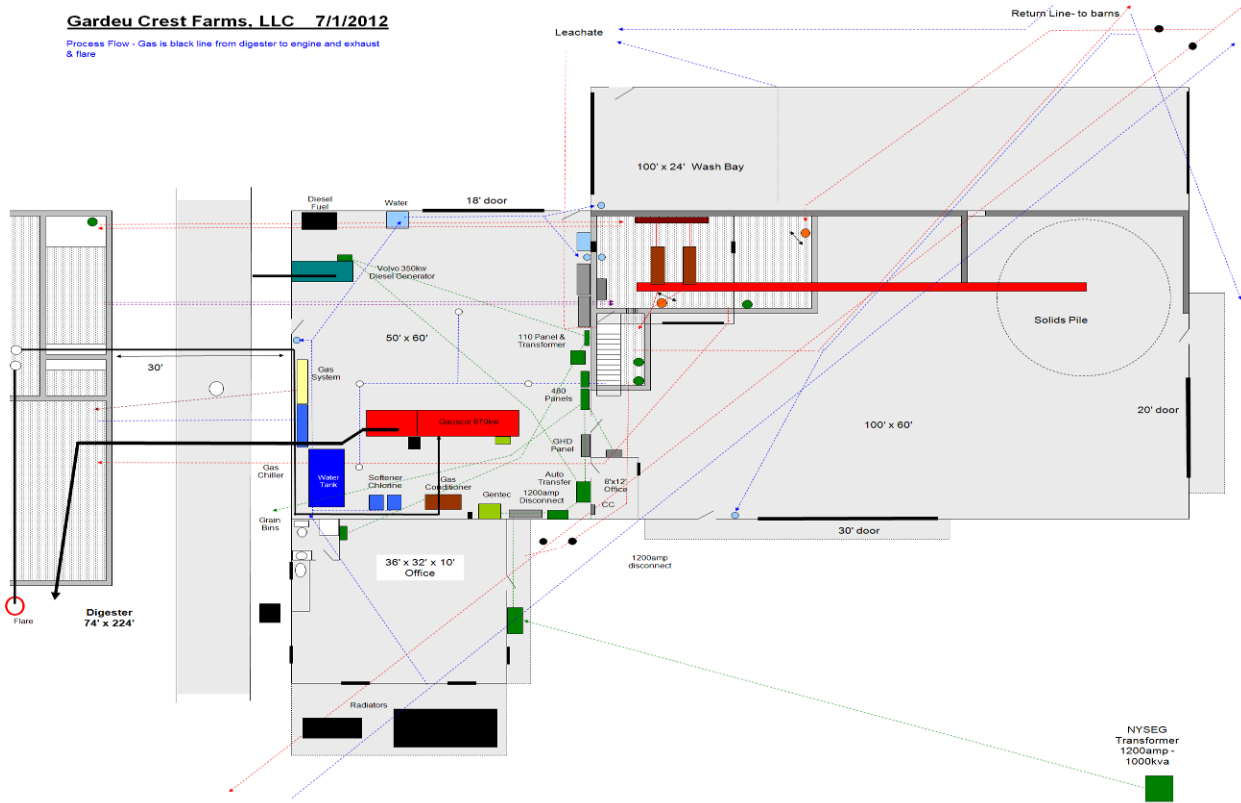


Figure 3 - Biogas System Schematic

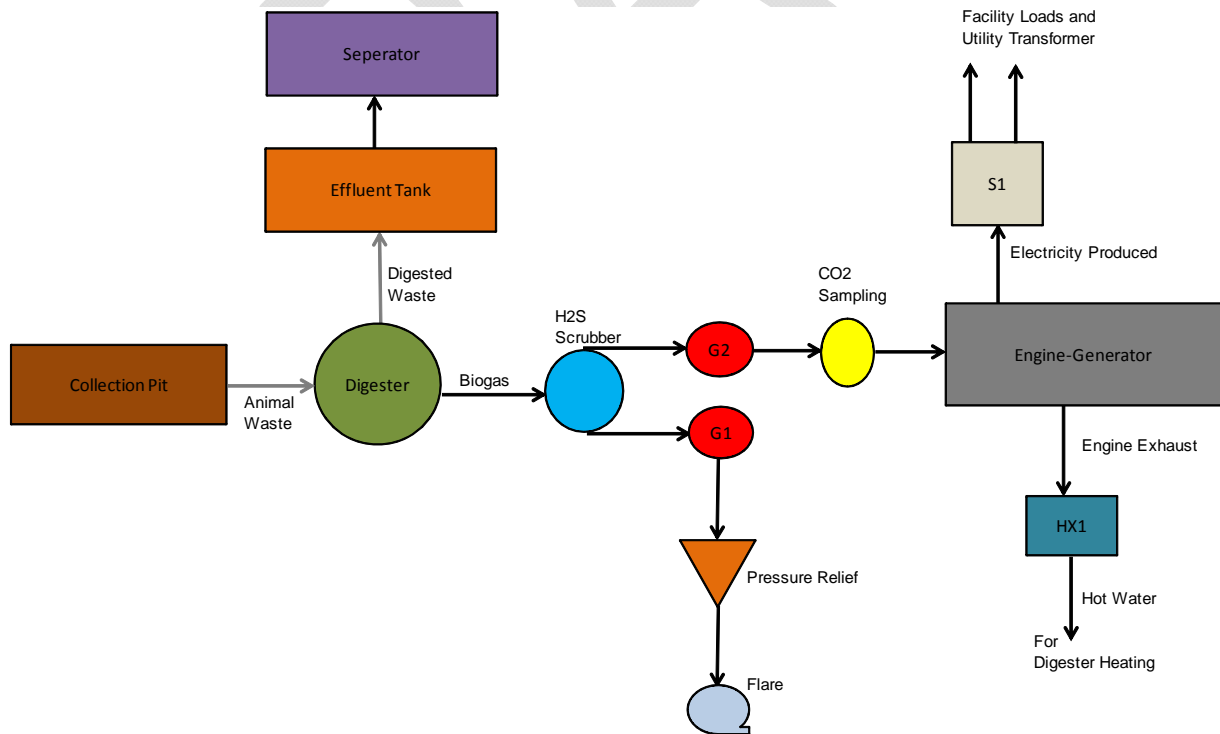


Figure 4 – Process Flow Diagram

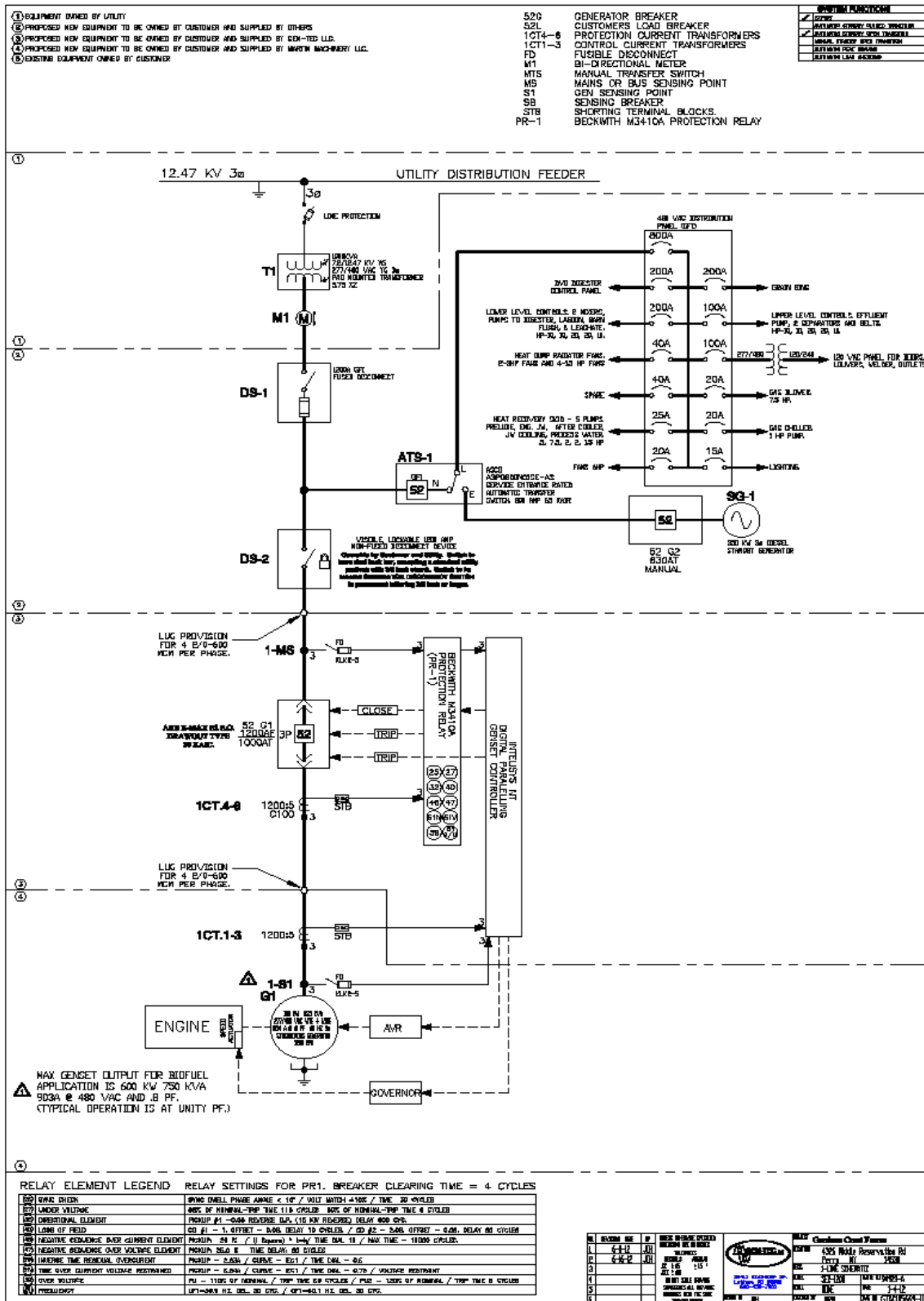


Figure 5 - Single Line Electrical Diagram

Monitoring System Equipment, Installation, Operation, and Maintenance

Figure 4 shows the location of the meters used to measure fuel gas input to the engine-generator (G2), to the flare (G1) and meter (S1) used to measure the kilowatts generated. Information on these data points is shown in Table 2.

Table 2 - Monitored Points for ADG System

Point Type	Point Name	Description	Instrument	Engineering Units	Expected Range
Pulse	S1	Engine-Generator Power	Intelisys Base Box IS-NT-BB with LCD display	kW	0 - 650 kW.
Pulse	G1	Engine Flare Flow	Sage Metering Inc. Model SIP-05-10-STC-05	SCFM	0 – 450 SCFM
Pulse	G2	Engine Biogas Flow	Sage Metering Inc. Model SIP-05-06-DC24-DIG-GAS	SCFM	0 – 350 SCFM

The electrical output of the engine-generator will be measured with the Intelisys NT engine controller. The controller will be installed in a stand alone cabinet on the wall of the engine room office. It has an external graphical display which shows real time and total kWh. The controller will be installed according to the requirements in the appropriate operator guide. The controller will be protected by a dedicated circuit breaker.

The biogas input to the engine will be measured by a Sage Prime mass flow meter (G2) that provides pulse output proportional to the volume flow that is compensated for temperature. A second Sage Prime mass flow meter (G1) will be installed to measure biogas flow to the flare. The meters will be installed and maintained according to the “Sage Thermal Gas Mass Flow Meter Operations and Instruction Manual for Models SIP/SRP,” as part of the engine generation equipment provided by Gen-Tec. A log of maintenance activities for the meters will be maintained at the site.

Intelisys power meter (S1) is illustrated to have an accuracy of 3%, as shown on the attached specification sheets. Accuracy for the installed current transformers is 1% as well as 1% for the two Sage gas meters, which are installed in-line in 4 inch schedule 40 PVC pipe. Documentation on this equipment and accuracies is attached to this plan.

The lower heating value for the biogas is estimated to be 580 Btu/ft³ based on past measurements of the CO₂ content of the biogas. This value will be verified weekly based on measurements of carbon dioxide using a Shawcity GFM400 Series Gas “Analyser” for CO₂ range 0-100%. The Farm staff will perform the CO₂ tests and log the results in the project log. This test is performed by taking a gas sample from the low pressure gas supply before it enters the gas conditioning equipment. The sampling point is marked in Figure 3 as “CO₂ Sampling”

There is no start-up or back-up fuel for this system.

A separate cabinet supplied by Gen-Tec mounted on the wall across from the controller houses the Red Lion HMI data logger. This unit collects, and assembles mass flow and power output data from the three monitoring points described in Table 2 into .csv format reports. A graphical display on the outside of the cabinet shows kWh production and mass flow information. The data logger will be programmed to record the totalized data for each monitoring point for each 15-minute interval. A record of all multipliers and data logger settings will be maintained.

The data logger will be connected to an uninterruptible power supply (UPS) to ensure the data logger retains its settings and data in the event of a power outage. The Farm will provide a static IP address that will be used by CDH Energy, the NYSERDA CHP Website Contractor, to communicate with the data logger. We have confirmed that CDH Energy will call the data logger nightly, via high speed modem link, to extract monitoring data from our ADG system and transfer the data to the NYSERDA CHP Website. If communications are lost, the Red Lion data logger is capable of holding up to 2 years of 15 minute interval data.

Management of Monitoring System Data

The Farm will perform the following quality assurance and quality control measures to ensure the data produced from our system accurately describes system performance.

On a daily basis, The Farm equipment manager will perform inspections of the digester and engine-generator equipment and record findings into the project log.

On a weekly basis, The Farm equipment manager will perform inspections of the QA/QC meter installations and complete the routine maintenance on the meters, noting any abnormalities or unexpected readings. The Farm will also maintain a weekly log of the cumulative power generation (kWh) from meter S1 and gas flow (cf or ft³) recorded by the Sage meters in the event that data transfer to the NYSERDA CHP Website fails or other anomalies occur.

On a weekly basis, The Farm staff will review the data stored in the NYSERDA CHP Website (chp.nyserdera.org) to ensure it is consistent with our observed performance of the ADG system and logged readings. The Farm will review the data using the reporting features at the website, including:

- Monitored Data – Plots and Graphs, and
- RPS: Customer-Sited Tier Anaerobic Digester Gas-to-Electricity Program NYSERDA Incentive Program Reports.

In addition, The Farm staff will also setup and use the email reports that are available at the CHP Website to help track the system performance, including:

- a periodic email report summarizing system performance and the estimated incentive,
- an email report sent out if data is not received at the web site or does not pass the quality checks.

The website will automatically take the data collected from the data-logger and evaluate the quality of the data for each 15-interval using range and relational checks. The expected ranges for the sensors (see Table 2) will be used for the range checks. The relational check will compare the kWh production data and gas production data for each interval to ensure both meters always provide non-zero readings at the same time (e.g., to detect if a meter has failed). Only data that passes the range and relational quality checks will be used in the incentive reports listed above. However, all hourly data is available from the NYSERDA CHP Website using the “Download (CSV file)” reporting option. In the event of a communications or meter failure, the farm will work with CDH Energy to resolve the issue in a few days.

If unanticipated loss of data occurs when the engine-generator continues to produce electricity, The Farm intends to follow the procedures outlined in Exhibit D, of their contract, i.e. use data from similar periods – either just before or after the outage - to replace the lost data. The Farm understands that they can use this approach for up to two 36 hour periods within each 12-month performance period. If more than two such data outages occur, The Farm will provide information from other acceptable data sources (e.g., weekly recorded logs) to definitively determine the amount of power that was being produced from biogas during the period in question.

Annual Performance Reports

Gardeau Crest Farms will prepare Annual Performance Reports summarizing the monthly data over the 12-month performance period. The reports will include a table (example provided below) showing the monthly kWh production, biogas use by the engine, and other data listed in Table 3, and if used, any heating oil or other fuel used for the engine. The Farm may use the NYSERDA Incentive Program Reports found on the CHP Website. Alternatively, they may provide their own summary of the data (using hourly CSV data downloaded from the Website) along with a narrative justifying why their data and calculations are more appropriate. The methods for calculating these values are provided below.

Additional Attachments to document

Cut sheets for:

Sage Metering Inc., Model SIP-05-06-DC24-DIG-GAS and SIP-05-10-DC24-DIG-GAS-PLUS Mass Flow Meter

ComAP Intelisys NT Controller IS-NT-BB

Shawcity GFM400 Series Gas “Analyser”

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