Emerling Farms Data Integrator Notes

The CHP system at Emerling Farm consists of a 200 kW Caterpillar engine run on Digester Gas. Heat is recovered from the engine by jacket water and exhaust. CHP data at this site is collected and managed by CDH Energy Corp.

Data Point Details

The data at this site is collected by a Campbell CR-10x Datalogger. The data is collected on a 5-minute interval and then made into hourly data for the online database. The data is summed, averaged or the maximum value is taken over the twelve 5-minute records constituting a single hourly record.

DG/CHP Generator Output (total kWh)
Data for this point comes from a Veris power transducer installed on the feed for the engine. The 15-minute data from the engine is summed into hourly data for the online database.

DG/CHP Generator Output Demand (peak kW)
Data for this point comes from a Veris power transducer installed on the feed for the engine. The maximum for each hour is taken for the hourly online database.

DG/CHP Generator Gas Use (total cubic feet)
Data for this point comes from a utility gas pulse output installed on the meter serving the microturbines. The pulses have a value of 100 cuft/pulse making the data coarse on an hourly basis. The 5-minute data is summed into hourly data for the online database. The data for this channel is best viewed on a daily basis.

Total Facility Purchased Energy (total kWh) and Demand (peak kW)
There is no data for these points available from the Campbell data.

Other Facility Gas Use (total cubic feet)
Data for this point comes from a utility gas pulse output installed on the meter serving the building. The pulses have a value of 100 cuft/pulse making the data coarse on an hourly basis. The 5-minute data is summed into hourly data for the online database. The only load for the facility gas use is the boiler. The data for this channel is best viewed on a daily basis.

Total Facility Energy (total kWh) and Total Facility Demand (peak kW)
There is no data for these points available from the Campbell data.

Unused Heat Recovery (total MBtu/h)
The Unused Heat Recovery is integrated by the Campbell datalogger on a 5-second interval. The difference in the heat recovery loop temperatures leaving and entering the turbine are integrated along with the flow rate and filtered using the valve statuses for the Chiller and boiler Heat Exchanger. Currently, where there is no boiler load the heat recovery is assigned as Unused (passive heat recovery only occurs through the boiler loop). The energy data is then summed into hourly data.

Unused Heat Recovery (total MBtu/h)
The Useful Heat Recovery is integrated by the Campbell datalogger on a 5-second interval. The heat recovery loop temperatures leaving and entering the turbine are integrated along with the flow rate and filtered using the valve statuses for the Chiller and boiler Heat Exchanger. Currently, where there is either a boiler or chiller load the heat recovery is assigned as Useful. The energy data is then summed into hourly data.

Status/Runtime of DG/CHP Generator (total hrs)
The turbine is defined as being fully on for a 5-minute interval if the turbine output is greater than 45 kW for the period (the fully-loaded capacity is 60 kW). The status is given a value of 0.083 if the generator output is above 45 kW and the generator output is divided by 45 kW if it is below for fractional runtime. The 5-minute data is then summed into hourly data for the online database.

Ambient Temperature (avg °F)
This point is measured directly by a Watlow thermocouple. The 5-minute data for a given hour is averaged for the online database.

Total CHP Efficiency (%)
The Total CHP Efficiency is calculated from the online hourly database as the sum of the Useful Heat Recovery and the DG/CHP Generator Output, converted from kWh to MBtus, divided by the DG/CHP Generator Gas Input. The gas input is converted to MBtus using the Lower Heating Value (LHV) of the fuel which is 0.930 MBtu/cubic foot (Natural Gas). Because of the coarse nature of the generator gas data, this channel is best viewed on a daily basis.

Electrical Efficiency (%)
The Electrical Efficiency is calculated from the online hourly database as the DG/CHP Generator Output, converted from kWh to MBtus, divided by the DG/CHP Generator Gas Input. The gas input is converted to MBtus using the Lower Heating Value (LHV) of the fuel which is 0.930 MBtu/cubic foot (Natural Gas). Because of the coarse nature of the generator gas data, this channel is best viewed on a daily basis.

Data Quality Checks

The Data Quality Checks consist of three levels of verification: does the data exist, does the data pass reasonable range checking and does the data pass relational checks. The methodology for applying the data quality checks begins by creating a contiguous database. This is necessary to maintain compatibility between the many sites on the server. Next, the data received for this site is fit into the database, in this case we are using 5-minute data. For any period where there is data, the data quality level is set to 3 for “Passes Relational Checks”. We then work backwards to identify data that does not meet Relational and/or Range Checking.

The next step is to apply the relational checks. Relational checks attempt to identify data which is uncorroborated by the rest of the data set. For instance, data received indicating a DG/CHP Generator output when the gas use is zero is suspect. For data failing a relational check, the data quality level is set to 2 for “Data Passes Range Checks”.

The last step is evaluating the range checks. The range checks consist of reasonable high and low values based on facility and DG/CHP Generator information. Data that falls outside the defined range for the database value has its data quality level set to 1 for "Data Exists."

It is necessary to work backwards when applying data quality checks to insure that data gets set to the lowest applicable data quality level. It is possible for data to pass the relational check and fail the range check and such data will be set to a data quality level of 1 for "Data Exists."

Table 1. Data Quality Definitions

Data Quality Levels	Description	Definition
3	Passes Relational Checking	This data passes Range Checks and Relational Checks. This is the highest quality data in the data set.
2	Passes Range Checks	This data passes the Range Checks but is uncorroborated by Relational Checks with other values.
1	Data Exists	This data does not pass Range Checks. This data is found to be suspect based on the facility and/or CHP equipment sizing.
0	Data Does Not Exist	This data is a placeholder for maintaining a contiguous database only.

Details on the Range and Relational Checks are found below.

Relational Checks

These checks are applied to the 5-minute data before it is converted to hourly data. If any of the 5-minute data points fails the relational check, the data for the entire hour is marked as failed.

Table 2. Relational Checks for Floyd Bennett Field

Evaluated Point	Criteria	Result
WG_KW	WG_KW > 5 and WG = 0	DQ Level for WG_KW set to 2

Notes: FG – DG/CHP Generator Gas Use
WG – DG/CHP Generator Output
WG_KW – DG/CHP Generator Demand

Range Checks

These checks are applied to the 5-minute data before it is converted to hourly data. If any of the 5-minute data points fails the range check, the data for the entire hour is marked as failed.

Table 3. Range Checks for Floyd Bennett Field

Data Point	Hourly Data Method	Upper Range Check	Lower Range Check
DG/CHP Generator Output	Sum	11 kWh	0 kWh
DG/CHP Generator Output Demand	Maximum	125 kW	0 kW
DG/CHP Generator Gas Use	Sum	500 cubic feet	0 cubic feet
Total Facility Purchased Energy	Sum	N/A	N/A
Total Facility Purchased Demand	Maximum	N/A	N/A
Other Facility Gas Use	Sum	500 cubic feet	0 cubic feet
Unused Heat Recovery	Sum	450 MBtu	0 MBtu
Useful Heat Recovery	Sum	450 MBtu	0 MBtu
Status/Runtime of DG/CHP Generator	Sum	0.166 hrs	0 hrs
Ambient Temperature	Average	130°F	-30°F

Notes: Data failing the Range Check has the data quality level set to 1 for "Data Exists"

ASERTTI Protocol Adherence

This site now adheres fully to the ASERTTI Long-Term Monitoring Protocol. All required performance parameters are being collected. The data is sampled in five second intervals and averaged or summed into 15-minute intervals as per the protocol. In addition, most of the optional parameters are available at this site.

The data did not adhere to the protocols before December 22, 2005. Prior to that date, generator gas use was not being collected by the data acquisition system due to a delay in paperwork processing by the gas utility.

Monitoring Notes

July 22, 2005

Installation of monitoring equipment complete with the exception of the building and generator gas use.

December 7, 2005

Building gas pulse channel successfully connected to the datalogger. There is no gas use data available for the building before this date.

December 22, 2005

Generator gas pulse channel successfully connected to the datalogger and verified. There is no gas use data available for the microturbines before this date.