Sheland Farms ADG Site - Data Integrator Notes

Sheland Farm's ADG system includes one reciprocating, biogas, engine that serve the electrical needs for the farm located in Adams, NY.

One 100 kW Caterpillar engine / generator serves the farm. The genset is located a building adjacent to the digester. All the recovered heat is captured in the form of hot water and used to heat the digester, preheat manure before entering the digester, and provide space heating.

Data Point Details

Data is logged at ***15-minute*** intervals by the Siemens PLC. The data is aggregated into hourly data and uploaded to the website.

The timestamp in the raw data files is in Eastern Standard Time. All data on the website is presented in Eastern Standard Time

DG/CHP Generator Output (total kWh)
The Generator Output comes from the data point Cogen Output Power in the Siemens log file. The difference between consecutive records is calculated for the energy use during the interval. This energy data is summed into hourly data.

DG/CHP Generator Output Demand (peak kW)
The Generator Output Demand is from the same data point as above, Cogen Output Power. The difference between consecutive records is calculated for the energy use during the interval. Instead of summing the kWh data, the highest kWh value per interval is multiplied by the number of intervals per hour to calculate the peak demand for the hour.

DG/CHP Generator Gas Input (cubic feet)
The data for Generator Gas Input comes from the data point FT-2 Gas Flow in the Siemens log file. The difference between consecutive records is calculated for the energy use during the interval. This flow data is then summed into hourly data.

Total Facility Purchased Energy (total kWh)
The data for Total Facility Purchased Energy comes from the data points Farm Load Power, Cogen Output Power, and Parasitic Load Power in the Siemens log file. It is calculated by subtracting the Cogen Output and Parasitic Loads from the Farm Load. The difference between consecutive records is calculated for the energy purchased during the interval. This energy data is summed into hourly data. This value will be negative when selling power back to the grid.

Total Facility Purchased Demand (peak kW)
The data for Total Facility Purchased Demand comes from the same data points as above (Farm Load Power, Cogen Output Power, and Parasitic Load Power), and is calculated the same way. The difference between consecutive records is calculated for the energy use during the interval. Instead of summing the kWh data, the highest kWh value per interval is multiplied by the number of intervals per hour to calculate the peak demand for the hour.

Other Facility Gas Use (cubic feet)
Other facility gas use represents the biogas being flared. The data for Other Facility Gas Use comes from the difference between data points FT-1 Gas Flow and FT-2 Gas Flow, from the Siemens log file. The difference between consecutive records is calculated for the energy use during the interval. This flow data is summed into hourly data.

Total Facility Energy (total kWh) and Total Facility Demand (peak kW)
Total Facility Energy is calculated by adding together the DG/CHP Generator Output and the Total Facility Purchased energy. Total Facility Demand is calculated by adding together the DG/CHP Generator Output Demand and Total Facility Purchased Demand.

Unused Heat Recovery (total MBtu/h)
No data

Useful Heat Recovery (total MBtu/h)
Useful Heat Recovery is calculated by multiplying 5.04 (multiplier that includes a constant flow rate of 42 gpm across the heat exchanger, density of water, and converts to flow per interval) by the difference between Engine Heat Exchanger Input Temperature and Engine Heat Exchanger Output Temperature. The difference between consecutive records is calculated for Useful Heat Recovered per interval. The interval data is then summed into hourly data.

Status/Runtime of DG/CHP Generator (hrs)
The generators are defined as being fully on over the interval if the generator output is greater than 10 kW / interval (the fully-loaded capacity is 100 kW / interval). The status is given a value of 0.166 if the generator output is above 10 kW. The data is then summed into hourly data for the online database.

Ambient Temperature (avg °F)
The Ambient Temperature comes from the Watertown Airport weather station. The data is downloaded from www.wunderground.com.

Electrical Efficiency (%)
The Electrical Efficiency is calculated by dividing Generator Output (WG) in BTU's by Generator Gas Input (FT-2) in BTU's. The energy density of biogas used is 600 BTU/cf. The expected efficiency should range from 20%-30%.

Total CHP Efficiency (%)
Same as electrical efficiency.

Data Quality Checks

The Data Quality Checks consist of three levels of verification:

- the data exist (flag=1),
- the data pass range checks (flag=2)
- the data pass relational checks (flag=3).

The methodology for applying the data quality begins by creating a contiguous database. We initially assume all data are good (flag=3) and 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 values which conflict with other data in 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 interval data before it is converted to hourly data. If any of the data points fails the relational check, the data for the entire hour is marked as failed.

Table 2. Relational Checks

Evaluated Point	Criteria	Result
FG	WG > 3 and FGE<20	DQ Level for FG set to 2

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

Range Checks

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

Table 3. Range Checks

Data Point	Hourly Data Method	Upper Range Check	Lower Range Check
DG/CHP Generator Output	Sum	90 kWh/hr	0 kWh/hr
DG/CHP Generator Output Demand	Maximum	90 kW	0 kW
DG/CHP Generator Gas Use	Sum	2,500 cf/hr	0 cf/hr
Total Facility Purchased Energy	Sum	100 kWh/hr	0 kWh/hr
Total Facility Purchased Demand	Maximum	100 kW	0 kW
Other Facility Gas Use	Sum	2,500 cf/hr	0 cf/hr
Unused Heat Recovery	Sum	-	-
Useful Heat Recovery	Sum	1,500 Mbtu/hr	0 Btu/hr
Status/Runtime of DG/CHP Generator	Sum	1 hrs	0 hrs
Ambient Temperature	Average	130°F	-30°F

Notes:

1. Data failing the Range Check has the data quality level set to 1 for “Data Exists”
2. Range checks are applied to interval data
3. This table contains the values from *range_checks.pro*