Riverpoint Towers Data Integrator Notes

This site is an apartment building located in the Bronx, New York. Five Tecogen generators provide electricity and heat is recovered from the engines to supplement space heating, domestic hot water and pool heating. Unused heat recovery is dissipated through a dump radiator. CHP data for this site is collected and managed by CDH Energy Corp.

Raw Data File and Data Point Details

The data at this site is collected by an Campbell CR10X datalogger. The data is collected on a 15-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 four 15-minute records constituting a single hourly record.

Table 1. Data Integrator Database Mapping

Integrated Data System Channel	Units of Measure	Raw Data Column Descriptions [channel]	Raw Data Units	Calculation Formula
DG/CHP Generator Output	kWh/int	Generator Power [WG], Parasitic Power [WP]	kWh	$=[WG]-[WP]$
DG/CHP Generator Output Demand	kW	Generator Power [WG], Parasitic Power [WP]	kWh	$=([WG]-[WP])*$ (60 min/hour ÷ 15 minutes/int)
DG/CHP Generator Gas Input	cuft/int	Generator Gas Use [FG]	cuft	$=[FG]$
Total Facility Purchased Energy	kWh/int	Facility Power [WT]	kWh	$=[WT]$
Total Facility Purchased Demand	kW	Facility Power [WT]	kWh	$=[WT]*$ (60 min/hour ÷ 15 minutes/int)
Other Facility Gas Use [2]	cuft/int	N/A	N/A	
Total Facility Energy	kWh/int	Calculated	kWh	
Total Facility Demand	kW	Calculated	kWh	
Useful Heat Recovery	Mbtu/int	Total Useful Heat Recovery [QU]	Mbtu/h	$=[QU]$
Unused Heat Recovery	Mbtu/int	Rejected Heat Recovery [QR]	Mbtu/h	$=[QR]$
Status/Runtime of DG/CHP Generator	hours	Calculated	hours	
Ambient Temperature[1]	°F	N/A	°F	
Total CHP Efficiency	% LHV	Calculated	N/A	
Electrical Efficiency	% LHV	Calculated	N/A	

[1] – Hourly Temperature from wunderground.com for the Westchester County airport has been substituted for the ambient temperature from the rawdata.

[2] – No data for this channel is available.

The details for each individual data point are outlined below.

DG/CHP Generator Output (total kWh)
Three power transducers and seven current sensors are installed on-site to measure the net generator power. Two transducers measure the power output through two transformers to the main 208V building feed while the third measures a 480V panel containing parasitic and non-parasitic loads. One-time power measurements are used along with the statuses to calculate the parasitic loads. The non-parasitic power is calculated by taking the 480V power minus the calculated parasitic power. The non-parasitic power is then added to the power through the transformer to calculate the net generator output. This 15-minute data is then summed into hourly data for the online database.

DG/CHP Generator Output Demand (peak kW)
This data point has the same source data as the DG/CHP Generator Output. The maximum 15-minute demand is assigned 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 engines. The 15-minute data is summed into hourly data for the online database

Total Facility Purchased Energy (total kWh)
Data for this point is collected from the Consolidated Edison DMS[1]. The 30-minute data is summed into hourly data for the online database. This data is updated on an irregular basis as Consolidated Edison makes more data available.

Total Facility Purchased Power (total kW)
This data point has the same source data as the Total Facility Purchased Energy. The maximum 30-minute demand is assigned for the hourly online database.

Other Facility Gas Use (total cubic feet)
There is no data for this point available from the Campbell data.

Total Facility Energy (total kWh) and Total Facility Demand (peak kW)
The sum of the Facility Purchased Channels and the Generator Channels is used.

Useful Heat Recovery (total MBtu)
The Useful Heat Recovery is integrated from loop temperature and flow on a 5-second interval. The heat recovery is calculated by taking the temperature difference between the loop leaving the engines and before the dump radiator (in ºF) and then multiplied by the total flow (in gallons) and the heating content factor for pure water (8.33 Btu-F-gal). The 15-minute heat recovery is summed for the hourly data.

[1] http://www.conedisondms.com/con_edison/

Unused Heat Recovery (total MBtu/h)

The Unused Heat Recovery is integrated from loop temperatures and flow on a 5-second interval. The heat recovery is calculated by taking the temperature difference between the loop before and after the dump radiator (in ºF) and then multiplied by the total flow (in gallons) and the heating content factor for pure water (8.33 Btu-F-gal). The 15-minute heat recovery is summed for the hourly data.

Status/Runtime of DG/CHP Generator (total hrs)

An engine is defined as being fully on for a 15-minute interval if the total generator output is greater than 40 kW above the nominal power for the period (the fully-loaded capacity of reach generator is 75 kW). The status is given a value of 0.25 hrs (15 minutes) times the number of generators operating for that 15-minute interval. For example, if the gross generator power is 270 kW for the interval, three generators operating continuously would provide 225 kW, leaving 45 kW (which is greater than 40 kW) meaning a fourth generator was operating for the majority of the period. Under that scenario, the status would get a value of 1.0 hours for that 15-minute interval. The 15-minute status data is then summed into hourly data for the online database.

Ambient Temperature (avg °F)

The Ambient Temperature comes from hourly sampled conditions at Westchester County Airport available at http://www.wunderground.com. The hourly data from the weather underground (which is often recorded at irregular time intervals) is assigned to the closest hour for the Ambient Temperature in 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.

Equation 1. Formula for Total CHP Efficiency

$$EFF_{chp} = \frac{\left(WG \times 3.413 \frac{MBtu}{kWh}\right) + QU}{FG \times 0.93 \frac{MBtu}{cu\ ft}}$$

Where:

EFF_{chp} = Total CHP Efficiency (%)

WG = DG/CHP Generator Output (total kWh)

QU = Useful Heat Recovery (MBtu)

FG = DG/CHP Generator Gas Input (cubic feet)

The Electrical Efficiency does not include any heat recovery, and is also based on the lower heating value (LHV) of natural gas for this site.

Equation 2. Formula for Electrical Efficiency

$$EFF_{elec} = \frac{\left(WG \times 3.413 \frac{MBtu}{kWh} \right)}{FG \times 0.93 \frac{MBtu}{cu\ ft}}$$

Where:
EFF_{elec} = Total CHP Efficiency (%)
WG = DG/CHP Generator Output (total kWh)
FG = DG/CHP Generator Gas Input (cubic feet)

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 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 15-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" or 1 for "Data Exists".

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 2. 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

There are no relational checks in place right now.

Range Checks

These checks are applied to the 15-minute data before it is converted to hourly data. If any of the 15-minute data points fails the range check, the data for the entire hour is marked as failed.

Table 3. Range Checks for Riverpoint Towers

Data Point	Hourly Data Method	Upper Range Check	Lower Range Check
DG/CHP Generator Output	Sum	100 kWh	-0.5 kWh
DG/CHP Generator Output Demand	Maximum	400 kW	-2 kW
DG/CHP Generator Gas Use	Sum	1000 cubic feet	0 cubic feet
Total Facility Purchased Energy	Sum	250 kWh	0 kWh
Total Facility Purchased Demand	Maximum	1000 kW	0 kW
Other Facility Gas Use	Sum	N / A	N / A
Unused Heat Recovery	Sum	2500 MBtu	-10 MBtu
Useful Heat Recovery	Sum	2500 MBtu	-10 MBtu
Status/Runtime of DG/CHP Generator	Sum	1.25 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 adheres fully to the ASERTTI Long-Term Monitoring Protocol. Data is provided in 15-minute intervals satisfying the protocol. In addition, this site also has some of the optional performance parameters.

Monitoring Notes

March 22, 2008

Installation of the Campbell datalogger was begun. The flow meter and several power transducers could not be installed.

May 9, 2008

The flow meter was installed and heat recovery data begins.

June 5, 2008

Installation of the Campbell datalogger is completed. Collection of the generator power data begins.