666 5th Ave Data Integrator Notes

This site is a CHP system, operated by Office Power, LLC., which includes ten (10) Elliot TA-100 100 kW micro-turbine units. Thermal output from the units will be used to meet various hot water loads in the facility, and run a hot-water absorption chiller during the summer. A dump radiator will reject any unneeded thermal energy. Data collection and monitoring for this site is completed by CDH Energy Corp.

Data Point Details

The data at this site is collected through an OfficePower ALC system using an Obvius data logger. Sample for each data channel are taken on the order of once per second, and 1,440 1-minute data records are produced for the raw data collected from this site. This raw data is summed, averaged, or the maximum value is taken for each set of 60-records, resulting in the hourly data uploaded to the Data Integrator website. The resulting hourly data is uploaded on a nightly basis. The details for each individual data point are outlined below.

The timestamp in the raw data files is in GMT, which is converted to Eastern Standard Time. All graphical figures on the website are presented in Eastern Standard Time. This means that during the Daylight Savings Time period from the first Sunday in April until the last Sunday in October the monitored data plots, CSV output and standardized PDF reports are in Eastern Standard Time and do not obey Daylight Savings time rules. Presenting data in Standard Time throughout the year is common practice for graphical time series plotting because it eliminates skipping an hour in April and duplicating an hour in October.

DG/CHP Generator Output (total kWh)

The data for Generator Output is computed from the difference of the accumulated energy production values reported by the ALC system. The difference between the current 1-minute accumulator value and the previous accumulator value is the total energy produced by the microturbine arrays, during that 1-minute period. The columns of origin for these data points are labeled “Turbine Array 1 Net Energy Export” and “Turbine Array 2 Net Energy Export” in the data files received from the Obvius logger. This 1-minute energy data is then summed into hourly data.

DG/CHP Generator Output Demand (peak kW)

The data for Generator Output Demand comes from 1-minute demand data for the two turbine arrays. The columns of origin for these data points are labeled “Turbine Array 1 Demand Export” and “Turbine Array 2 Demand Export” in the data files received from Obvius logger. The maximum 1-minute demand for a given hour is assigned to the hourly database.

DG/CHP Generator Gas Input (cubic feet/hour)

A single gas pulse meter was installed on March 11, 2010. Gas data begins at this point. The pulser is read by the PLC, and represents a running average of high density pulses in cubic feet/hour (CFH). The data logger reports the 1-minute average of these CFH readings. The 1-minute average data is converted into cubic feet / interval and summed into hourly data. Note

that only one pulse meter is used, as the utility supplied metering arrangement has changed from the original design.

Total Facility Purchased Energy (total kWh)
The data for total facility purchased energy is computed from the difference of the accumulated energy production values reported by the ALC system. The difference between the current 1-minute accumulator value and the previous accumulator value is the total energy produced by the microturbine arrays, during that 1-minute period. The columns of origin for these data points are labeled "Service 1 Energy Import", "Service 2 Energy Import", "Service 3 Energy Import", and "Service 4 Energy Import" in the data files received from the Obvius logger. This 1-minute energy data is then summed into hourly data.

Total Facility Purchased Demand (peak kW)
The data for Total Facility Purchased Demand comes from 1-minute demand data for the three building electrical services arrays. The columns of origin for these data points are labeled "Service 1 Demand Import", "Service 2 Demand Import", and "Service 3 Demand Import", "Service 4 Demand Import" in the data files received from the Obvius logger. The maximum 1-minute demand for a given hour is assigned to the hourly database.

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

Total Facility Energy (total kWh) and Total Facility Demand (peak kW)
These two data points are the sum of the DG/CHP Generator Output and Total Facility Purchased Energy and Demand points.

Unused Heat Recovery (total MBtu)
The unused heat recovery is calculated by the recorded temperature difference across the glycol piping header where the dump radiator is located, and the flow through the glycol piping header. The heat transfer will be calculated on a 1-minute basis, then summed into hourly data.

Useful Heat Recovery (total MBtu)
The useful heat recovery is calculated by the recorded temperature difference across the water side of the glycol heat exchanger, and the flow through the water side of the heat exchanger. The heat transfer will be calculated on a 1-minute basis, then summed into hourly data. When the glycol flowmeter is installed, useful heat recovery will be calculated on the glycol side of the HX.

Status/Runtime of DG/CHP Generator (hrs)
The turbine arrays are defined as, being fully on for a 1-minute interval if the generated power is greater than 90 kW for the period. The status is given a value of 1/60 if the generated output is above 90 kW. The 1-minute data is then summed into hourly data for the online database.

Ambient Temperature (avg °F)
The Ambient Temperature comes from hourly sampled conditions at JFK International 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 0.920 MBtu/cubic foot (Natural Gas).

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 0.920 MBtu/cubic foot (Natural Gas

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 1-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 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 1-minute data before it is converted to hourly data. If more than 75% of the 1-minute data points fail the relational check, the data for the entire hour is marked as failed. When there is a failure to obtain new data, the data set repeats the old value. We can identify this bad data through a relational check for repeating data on the equipment separately. We are using a threshold of 95% repeating values because some values can reset to zero during the repeating periods.

Table 2. Relational Checks for 666 5th Ave

Evaluated Point	Criteria	Result
FG	WG > 2 and FG <=0	DQ Level for FG set to 2
WG	FG > 10 and WG <=0	DQ Level for WG set to 2
WG, WG_KW, SG	> 95% of columns "Service 1 Energy Import" through "Turbine Array 2 Demand Export" repeat previous data record	DQ Level for WG_KW, WG and SG set to 1

Notes: FG – DG/CHP Generator Gas Use
WG – DG/CHP Generator Output
WG_KW – DG/CHP Generator Demand
SG – Status/Runtime of DG/CHP Generator

Range Checks

These checks are applied to the 1-minute data before it is converted to hourly data. If more than 75% of the 1-minute data points fail the range check, the data for the entire hour is marked as failed. . When there is a failure to obtain new data, the data set repeats the old value.

Table 3. Range Checks for 666 5th Ave

Data Point	Hourly Data Method	Upper Range Check	Lower Range Check
DG/CHP Generator Output	Sum	40 kWh/min	-5 kWh/min
DG/CHP Generator Output Demand	Maximum	1050 kW	-150 kW
DG/CHP Generator Gas Use	Sum	300 cubic feet/interval	0 cubic feet
Total Facility Purchased Energy	Sum	200 kWh/min	0 kWh/min
Total Facility Purchased Demand	Maximum	6000 kW	0 kW
Other Facility Gas Use	Sum	N/A	N/A
Unused Heat Recovery	Sum	200 MBtu	0 MBtu
Useful Heat Recovery	Sum	200 MBtu	0 MBtu
Status/Runtime of DG/CHP Generator	Sum	8/60 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 to the ASERTTI Long-Term Monitoring Protocol with the following exception: the Inlet Air Temperature is not measured. For analysis, the outdoor air temperature from a nearby weather station has been substituted. All other required performance parameters are reported in 1-minute averages and sums or can be calculated.

Monitoring Notes

November 5, 2009

Obvius data logger installed, data logging begins

March 11, 2010

Natural gas pulse output installed by utility – data collection on gas use begins.

April 8, 2010

Data base updated to include gas data.

March 25, 2011

Modified the threshold for relational checks and range checks so that 75% passing data is required to pass an hour instead of 100%. Fixed an issue where gas use was flagged as failing a relational check when power should have been flagged.