Ten West 66th Street Corporation Data Integrator Notes

This site is a condominium complex located in New York City. The site has a 70 kW Ingersoll-Rand microturbine that provides heat recovery for domestic hot water. Data for this site is collected by Connected Energy and provided to CDH Energy.

Data Point Details

The data at this site is provided by Connected Energy in the form of comma-separated value (CSV) files. There is one file for each day containing 15-minute timestep data for 49 data points. One data file is uploaded on a nightly basis containing the previous days data. From these 15-minute values, the hourly database is formed. It is unclear whether the 15-minute data is sampled or averaged across the interval. The details for each individual data point are outlined below.

The timestamp in the raw data files is in Eastern Local Time. This means it obeys the Standard to Daylight savings times rules for the Eastern timezone. For display purposes, we convert the timestamp from Local Time to Eastern Standard Time for all graphical figures on the website. 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 comes from a 15-minute average for turbine demand. The column of origin for this data point is labeled "Optional KW Transmitter" in the data files received from Connected Energy. This 15-minute interval demand data is converted to energy and then summed into hourly data.

DG/CHP Generator Output Demand (peak kW)
The data for Generator Output Demand comes from a 15-minute average for turbine demand. The column of origin for this data point is labeled "Optional KW Transmitter" in the data files received from Connected Energy. The maximum for a given hour is assigned to the hourly database.

DG/CHP Generator Gas Input (cubic feet)
The data for Generator Gas Input comes from an accumulator sampled every 15-minutes for total gas use. The column of origin for this data point is labeled "MTG Cumul. Fuel Consumption" in the data files received from Connected Energy. The difference between consecutive records is assigned as the turbine gas use for that interval. This 15-minute interval gas data is then summed into hourly data.

Total Facility Purchased Energy (total kWh)
The data for Facility Purchased Energy comes from an accumulator sampled every 15-minutes for the total electric utility import. The column of origin for this data point is labeled "Building Use Cumul. Electric" in the data files received from Connected Energy. The difference between

consecutive records is assigned as the purchased energy for that interval. This 15-minute interval energy data is then summed into hourly data.

Total Facility Purchased Demand (peak kW)
The data for Facility Purchased Demand comes from a 15-minute average for electric demand import. The column of origin for this data point is labeled "Building Use Electric Rate" in the data files received from Connected Energy. The maximum for a given hour is assigned to the hourly database.

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

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 data points.

Unused Heat Recovery (total MBtu/h)
There is no data available for this point from the Connected Energy data.

Useful Heat Recovery (total MBtu/h)
The Useful Heat Recovery comes from an accumulator sampled every 15-minutes for the generator heat recovery. The column of origin for this data point is labeled "Cumul. MTG Heat Rec" in the data files received from Connected Energy. The difference between consecutive records is then multiplied by 62.44 pounds per cubic foot of water for 15-minute interval energy data. With the conversion factor of 62.44, calculating the total CHP efficiency yields results very close to the column labeled "MTG CHP Efficiency" in the Connected Energy data files. This 15-minute energy data is then summed into hourly data.

Status/Runtime of DG/CHP Generator (hrs)
The turbine is defined as being fully on for a 15-minute interval if the turbine power is greater than 55 kW for the period (the fully-loaded capacity is 70 kW). The status is given a value of 0.25 if the generator output is above 55 kW and the generator output is divided by 55 kW if it is below. The 15-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). The LHV of

the fuel is assumed from comparing the calculated electrical efficiency to the datapoint labeled "MTG Elect Efficiency" in the Connected Energy data files.

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). The LHV of the fuel is assumed from comparing the calculated electrical efficiency to the datapoint labeled "MTG Elect Efficiency" in the Connected Energy data files.

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 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 15-minute data before it is converted to hourly data. If any of the 15-minute data points fails the relational check, the data for the entire hour is marked as failed. Columns from "Generator Phase A Current" through "Cogen Energy" represent one piece of equipment that contains information for most of the data points. Columns from "Generator Phase A Current" through "Cogen Energy" represent data for the Engine Controller and contain data for the Generator Output and Generator Output Demand. 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 two pieces of equipment separately. We are using a threshold of 90% repeating values because some values can reset to zero during the repeating periods.

Table 2. Relational Checks for Ten West 66th Street

Evaluated Point	Criteria	Result
FG	WG > 10 and FG <=0	DQ Level for FG set to 2
WG, WG_KW, SG	> 90% of columns "Generator Phase A Current" through "Cogen Energy" 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 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. At this site we know that there are separate pieces of equipment involved in the monitoring data. Columns from "Generator Phase A Current" through "Altitude At Installation" represent one piece of equipment that contains information for most of the data points. 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 this piece of equipment. We are using a threshold of 80% because some values can reset to zero during the repeating periods. During normal communication, no more than 60% of the channels repeat identical values.

Table 3. Range Checks for Ten West 66th Street

Data Point	Hourly Data Method	Upper Range Check	Lower Range Check
DG/CHP Generator Output	Sum	17.5 kWh	0 kWh
DG/CHP Generator Output Demand	Maximum	70 kW	0 kW
DG/CHP Generator Gas Use	Sum	1200 cubic feet	0 cubic feet
Total Facility Purchased Energy	Sum	150 kWh	0 kWh
Total Facility Purchased Demand	Maximum	600 kW	0 kW
Other Facility Gas Use	Sum	N/A	N/A
Unused Heat Recovery	Sum	N/A	N/A
Useful Heat Recovery	Sum	600 MBtu	0 MBtu
Status/Runtime of DG/CHP Generator	Sum	0.25 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 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 15-minute averages and sums or can be calculated.

Monitoring Notes

November 18, 2005

CDH begins receiving daily file uploads from Connected Energy for this site.