Seapark West Apartment Complex - Data Integrator Notes

Seapark West's cogeneration plant includes two engine-generators that serve the electrical services for the apartment complex in Brooklyn, NY.

Two 75 kW units serve the facility. Both engines are located in a maintenance room adjacent to the facility's boiler room.

Data Point Details

Data is logged at 1-minute intervals by and AcquiSuite datalogger. The data is aggregated into hourly data and uploaded to the web site.

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 data for Generator Output is calculated by adding data points WE1 and WE2, then subtracting WP, after they are calculated from the accumulators in the AcquiSuite log file. The difference between consecutive records is calculated to determine the energy use during the interval. This 1-minute interval data is then summed into hourly data.

DG/CHP Generator Output Demand (peak kW)
The Generator Output Demand is calculated by adding data points WE1 and WE2 and subtracting WP, the same as above. The difference between consecutive records is calculated to determine the energy use during the interval. Instead of summing the kWh data, the highest kWh per interval value is multiplied by 60 in order to calculate the peak demand for the hour.

DG/CHP Generator Gas Input (cubic feet)
The data for Generator Gas Input comes the accumulator records for FG in the AcquiSuite log file. The difference between consecutive records is calculated to determine the gas use during the interval. The 1-minute data is then summed into hourly data for the online database.

Total Facility Purchased Energy (total kWh)
This data will be taken from the Con Ed DMS website when the data is available.

Total Facility Purchased Demand (peak kW)
This data will be taken from the Con Ed DMS website when the data is available.

Other Facility Gas Use (cubic feet)
No data

Total Facility Energy (total kWh) and Total Facility Demand (peak kW)
No data.

Unused Heat Recovery (total MBtu/h)
The Unused Heat Recovery comes from 1-minute data for the data points FW, THR1, and THR2 from the AcquiSuite log file, and is calculated as such:

QR = 500*FW*(THR1-THR2) /1000 (MBtu/h)

Unused heat recovery represents heat dumped to the atmosphere from the hot water loop via the dump radiator. This happens when the return temperature of the water loop is too high to effectively cool the engines. This is calculated using the flow between the engine and heat exchanger (FW), heat exchanger return temperature (THR1), and engine supply temperature (THR2). The multiplier was computed by converting gpm to gph (60 min/hr), and by converting the volumetric flow rate to a mass flow rate (multiply by the density of water). The 1-minute data is then averaged into hourly data for the online database.

Useful Heat Recovery (total MBtu/h)
The Useful Heat Recovery comes from 1-minute data for the data points FW, THS, THR1, FB, TBS, and TBR from the AcquiSuite log file, and is calculated as such:

Q=500*[FW*(THS-THR1)+FB*(TBS-TBR)] /1000 (MBtu/h)

The Useful Heat Recovery comes from 1-minute data for the useful heat from hot water. It is made up of heat sent to the boiler loop and heat sent to the service hot water loop. The flow between the engine and heat exchanger is multiplied by the difference between the engine supply temperature and the heat exchanger return temperature. Flow between exhaust heat exchanger and boiler is then multiplied by the difference in the boiler supply temperature and the boiler return temp. These two values are added together and multiplied by a constant that was calculated thru the conversion of gpm to gph and multiplying by density. The columns of origin for these points are FW for water loop flow, THS for water supply temp, THR for water return temp, FB for flow between the exhaust heat exchanger and boiler, TBS for boiler supply temperature, and TBR for boiler return temperature. The 1-minute data is then averaged into hourly data for the online database

Status/Runtime of DG/CHP Generator (hrs)
The generators are defined as being fully on for a 1-minute interval if the generator output is greater than 30 kW per 1 minute interval (the fully-loaded capacity is 75 kW/generator). The status is given a value of 1 (or two if both generators are on) if the generator output is above 30 kW. The 1-minute data is then averaged into hourly data for the online database.

Ambient Temperature (avg °F)
The data for Ambient Temperature comes from hourly data from recorded data at http://www.wunderground.com/, for John F. Kennedy Airport (JFK).

Electrical Efficiency (%)
The Electrical Efficiency is calculated by dividing the Generator Output (WE1+WE2-WP) in BTU's by the Generator Gas Input (FG) in BTU's. The energy density of natural gas used is 930 BTU/cf. The expected efficiency should range from 20%-30%.

Total CHP Efficiency (%)
The Total CHP Efficiency is calculated similarly to Electrical Efficiency above, except the Useful Heat Recovery (Q) and the Generator Output (WE1+WE2-WP) are summed before being divided by the Gas Input (FG) in MBTU's.

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 1-minute data before it is converted to hourly data. If 25% or less of the data fails the range check, the failed data is excluded and the remaining data is used for the hour. If more than 25% of the 1-minute data points fails the range check, the data for the entire hour is marked as failed and the hour is calculated normally.

Table 2. Relational Checks for Seapark West

Evaluated Point	Criteria	Result
FG	WG > 5 and FG < 3	DQ Level for FG set to 2

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

Range Checks

These checks are applied to the 1-minute data before it is converted to hourly data. If 25% or less of the data fails the range check, the failed data is excluded and the remaining data is used for the hour. If more than 25% of the 1-minute data points fails the range check, the data for the entire hour is marked as failed and the hour is calculated normally. Note that range checks for one minute data (and especially accumulators) are set to allow a large amount of variance.

Table 3. Range Checks for Seapark West

Data Point	Hourly Data Method	Upper Range Check	Lower Range Check
DG/CHP Generator Output	Sum	4 kWh	-1 kWh
DG/CHP Generator Output Demand	Maximum	240 kW	-5 kW
DG/CHP Generator Gas Use	Sum	110 cf	0 cf/int
Total Facility Purchased Energy	Sum	-	0 kW
Total Facility Purchased Demand	Maximum	-	0 kW
Other Facility Gas Use	N/A	-	-
Unused Heat Recovery	Average	1500 MBtu	-100 MBtu
Useful Heat Recovery	Average	1500 MBtu	-100 MBtu
Status/Runtime of DG/CHP Generator	Average	2 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”

Site Notes:
9/25/2009:
Data collection begins

10/8/2009:
The RTD sensor for TBS is no longer working properly. Boiler heat recovery is currently being set to zero until this issue is resolved. Heat recovered through domestic hot water is unaffected.

11/24/2009:
Added a 24 VDC supply, moved FG to expansion board. Expansion board is now separately powered with its own power supply. The issue with TBS has been resolved and the boiler heat recovery is now being properly added into the total heat recovery.

4/5/2010:
Switched the datalogger to send 1 minute data instead of 5 minute data. This was done to aide in the debugging of several issues.

4/7/2010:
Pulse counts from the fuel meter were not being counted properly, adjusted the closed resistance threshold for pulse readings on the data logger from 1000 to 2500. Switched the RTD sensors to thermistors.

6/16/2010:
Installed new veris 10k type 2 Curve on the obvius datalogger.

9/28/2010:
Updated documentation. Changed the date that thermistor offsets were being applied to temperatures too 4/7/2010 (was 7/4/2010). Modified range checks to account for 1 min data. Fixed the calculation of dumped heat recovery to use FW (HX flow rate) instead of FB (boiler flow rate).

3/28/2011:
Updated the airport to John F. Kennedy (which is closer to the site) for ambient temperature data collection.