East Rochester Scholl District Data Integrator Notes

This site uses a model 200 fuel cell system from UTC Power, a United Technologies Corp. (NYSE: UTX). Thermal output from the units will be used to heat the domestic hot water and pre-heat the boiler water. Data collection for this site is completed by ATSI.

Data Point Details

Beginning on June 11, 2008, ATSI began submitting data to CDH Energy data for the East Rochester School District fuel cell plant located in East Rochester, NY. The data is uploaded to CDH once a day and contains 15-minute data for generator power output, facility power import, gas use, and heat recovery use. The data is summed, averaged, or the maximum value is taken for each set of records constituting a singly hourly record. The resulting data is uploaded on a nightly basis containing the previous days data. 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 time 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 evaluation of the average output from the fuel cell. The column of origin for these data points is labeled “total generator electricity” in the received data files. This 15-minute demand data is then averaged into hourly data.

DG/CHP Generator Output Demand (peak kW)
The data for Generator Output Demand comes from a 15-minute evaluation of the average output from the fuel cell. The column of origin for these data points is labeled “fuel cell output” in the received data files. 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 a 15-minute accumulator reading where the usage for that period is equal to the difference between two periods. The column of origin for these data points is labeled “cumulative natural gas consumed” in the received data files. The 15-minute data is then summed into hourly data.

Total Facility Purchased Energy (total kWh)
The data for purchased energy comes from a 15-minute evaluation of the average output from the grid. The column of origin for these data points is labeled “utility purchased electricity” in the received data files. This 15-minute demand data is then averaged into hourly data.

Total Facility Purchased Demand (peak kW)
The data for purchased energy demand comes from a 15-minute evaluation of the average output from the grid. The column of origin for these data points is labeled "Grid Power" in the received data files. 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.

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)
There is no data available for this point

Useful Heat Recovery (total MBtu)
The useful heat recovery comes from 15-minute data, which will be summed, into hourly data. This value will be calculated based on heat recovery obtained from the columns "domestic hot water heat recovery" and "boiler heat recovery". The value for, "total heat recovered" is then calculated by summing these two columns.

Status/Runtime of DG/CHP Generator (hrs)
The turbine arrays are defined as, being fully on for a 15-minute interval if the generated power is greater than 100 kW for the period. The status is given a value of 1/4 if the generated output is above 100 kW. The 15-minute data is then summed into hourly data for the online database.

Ambient Temperature (avg °F)
The Ambient Temperature comes from sampled 15-minute data sampled in the column "ambient temperature". It is averaged into 1-hour data.

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 any of the 1-minute data points fails 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 East Rochester School District

Evaluated Point	Criteria	Result
FG	WG > 10 and FG <=0	DQ Level for FG set to 2
WG, WG_KW, SG	> 95% of columns "grid import" through "fuel cell output" repeat previous data record	DQ Level for WG_KW, WG, QHR, 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
QHR – Total heat recovered

Range Checks

These checks are applied to the 1-minute data before it is converted to hourly data. If any of the 1-minute data points fails 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 East Rochester School District

Data Point	Hourly Data Method	Upper Range Check	Lower Range Check
DG/CHP Generator Output	Average	220 kWh	0 kWh
DG/CHP Generator Output Demand	Maximum	220 kW	-1 kW
DG/CHP Generator Gas Use	Sum	2500 cubic feet	0 cubic feet
Total Facility Purchased Energy	Average	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	N/A	N/A
Useful Heat Recovery	Sum	400 MBtu	0 MBtu
Status/Runtime of DG/CHP Generator	Sum	1/4 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

April 8, 2009

We started receiving data in June 2008, no valid data has been transmitted for heat recovery and the data upload has had stability issues due to sensor failures. The data upload is presently up and stable although no heat recovery data has been provided yet. The fuel accumulator is not regularly updating at each 15-minute interval and is randomly providing all the missed updates at once. Presently this is being handled by averaging the update across each period that the update accounts for. The amount of fuel being used during this period has been verified using the calculated electrical efficiency.