St Elizabeths CHP Plant Site - Data Integrator Notes

The St Elizabeths CHP Plant consists of 3 Caterpillar G3516TA 770 kW generators. Each generator is capable of supplying hot water, steam and base load power.

Data Point Details

This server uses the Niagara Ax/Obix Framework, which is supplied by Tridium. Data are logged at 15-minute intervals and are averaged or totaled for that period. TBS operates the server.

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 comes from the channel WGB (kWh). This energy data is summed across each hour.

DG/CHP Generator Output Demand (peak kW)
The Generator Output Demand comes from the channel WGB (kWh) . The reading is converted to kW and the highest value from the 15-minute data during an hour is used for the Output Demand in the online database.

DG/CHP Generator Gas Input (cubic feet)
The data for Generator Gas Input comes from the channel FG_ACC (cf). The data is summed into hourly data for the online database.

Total Facility Purchased Energy (total kWh)
The data for Facility Purchased Energy comes from the channels WT1 and WT2 (kWh). These channels are summed across each hour.

Total Facility Purchased Demand (peak kW)
The data for Facility Purchased Demand comes from the channels WT1 and WT2 (kWh). The channels are converted to kW, added together for each 15 minute interval and the maximum value is used for each hour.

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)
The Unused Heat Recovery is calculated using the useful heat recovery across the heat exchanger for each cogen loop. The useful heat recovery for each hot water loop is used to determine the approximate flow for each cogen loop and that flow is used to calculate the heat dispersed across each dump radiator. The calculations are as follows:

QN = .5*FXSN*(TXSLN - TXSEN)
FN = QN/(.5*(TXPEN-TXPLN))
QDN = .5*FN*(TXPLN - THEN)

Where N represents the number of the cogen loop, QN is the useful heat recovery, FN is the estimated flow in the cogen loop, and QDN is the unused heat recovery. The unused heat recovery is calculated with in units of MBtu/h and is averaged across each hourly interval.

Useful Heat Recovery (total MBtu)
The Useful Heat Recovery comes from the channels FSM (lb/h), FWH4 (gpm), TLW, and TE602 (F). FSM is converted to MBtu/h using 1.0194 Mbtu/lb. The heat transfer on the hot water side is calculated:

QHR = .5*FWH4*(TLW - TE602) (Mbtu/h)

Both channels are converted to Mbtu and summed across each hour.

Status/Runtime of DG/CHP Generator (hrs)
The 3 770 kW generators are defined as being fully on for a 15-minute interval if the generator output is greater than 200 kW for the period. The status for each 15 minute interval is increased by 1 for each unit that is active. The 15-minute data is then averaged into hourly data for the online database.

Ambient Temperature (avg °F)
The data for Ambient Temperature comes from the channel TAO. The data point obtained represents the average temperature for each day. The temperature reading is spread across the day as hourly 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 0.930 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 0.930 MBtu/cubic foot (Natural Gas).

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 interval data before it is converted to hourly data. If any of the interval data points fails the relational check, the data for the entire hour is marked as failed.

Table 2. Relational Checks

Evaluated Point	Criteria	Result
FG	WG > 50 and FGE<=0	DQ Level for FG set to 2
QD	QD > FGE and FGE >= 500	DQ Level for QD set to 2

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

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

Data Point	Hourly Data Method	Upper Range Check	Lower Range Check
DG/CHP Generator Output	Sum	750 kWh	0 kWh
DG/CHP Generator Output Demand	Maximum	3000 kW	0 kW
DG/CHP Generator Gas Use	Sum	8000 cf	0 cf
Total Facility Purchased Energy	Sum	2000 kWh	0 kWh
Total Facility Purchased Demand	Maximum	8000 kW	0 kW
Other Facility Gas Use	Sum	-	-
Unused Heat Recovery	Sum	30000 Mbtu	-90 MBtu
Useful Heat Recovery	Sum	30000 MBtu	-500 MBtu
Ambient Temperature	Average	130°F	-30°F

Notes: Data failing the Range Check has the data quality level set to 1 for “Data Exists”

Table 4. CDH and TBS point names.

CDH ID	TBS Server ID
TAO	CHP Building Outside Air
TAI	CHP Building Space Temp
TDE1	CHP CG-1 DCR Ent TE-110
SFD1	CHP CG-1 DCR Fan Status
TDL1	CHP CG-1 DCR Lvg TE-109
THE1	CHP CG-1 HT Loop Ent TE-102
THL1	CHP CG-1 HT Loop Lvg TE-101
TXPE1	CHP CG-1 HX Pri Ent TE-108
TXPL1	CHP CG-1 HX Pri Lvg TE-105
TXSE1	CHP CG-1 HX Sec Ent TE-106
FXS1	CHP CG-1 HX Sec Flow H-1
TXSL1	CHP CG-1 HX Sec Lvg TE-107
SPXS1	CHP CG-1 HX Sec Pump Status
TLE1	CHP CG-1 LT Loop Ent TE-104
TLL1	CHP CG-1 LT Loop Lvg TE-103
FSG1	CHP CG-1 Steam Generator
FSSP1	CHP CG-1 Steam SP-1
TDE2	CHP CG-2 DCR Ent TE-210
SFD2	CHP CG-2 DCR Fan Status
TDL2	CHP CG-2 DCR Lvg TE-209
THE2	CHP CG-2 HT Loop Ent TE-202
THL2	CHP CG-2 HT Loop Lvg TE-201
TXPE2	CHP CG-2 HX Pri Ent TE-208
TXPL2	CHP CG-2 HX Pri Lvg TE-205
TXSE2	CHP CG-2 HX Sec Ent TE-206
FXS2	CHP CG-2 HX Sec Flow H-2
TXSL2	CHP CG-2 HX Sec Lvg TE-207
SPXS2	CHP CG-2 HX Sec Pump Status
TLE2	CHP CG-2 LT Loop Ent TE-204
TLL2	CHP CG-2 LT Loop Lvg TE-203
FSG2	CHP CG-2 Steam Generator
FSSP2	CHP CG-2 Steam SP-2
TDE3	CHP CG-3 DCR Ent TE-310
SFD3	CHP CG-3 DCR Fan Status
TDL3	CHP CG-3 DCR Lvg TE-309
THE3	CHP CG-3 HT Loop Ent TE-302
THL3	CHP CG-3 HT Loop Lvg TE-301
TXPE3	CHP CG-3 HX Pri Ent TE-308
TXPL3	CHP CG-3 HX Pri Lvg TE-305
TXSE3	CHP CG-3 HX Sec Ent TE-306
FXS3	CHP CG-3 HX Sec Flow H-3
TXSL3	CHP CG-3 HX Sec Lvg TE-307
SPXS3	CHP CG-3 HX Sec Pump Status
TLE3	CHP CG-3 LT Loop Ent TE-304
TLL3	CHP CG-3 LT Loop Lvg TE-303
FSG3	CHP CG-3 Steam Generator
FSSP3	CHP CG-3 Steam SP-3
TAER	CHP Elec Rm Space Temp
ACH4	CHP Plant CH4 Alarm
ACO	CHP Plant CO Alarm
TEWCT2	CHP Plant CT-2 EW Temp
SFCT2	CHP Plant CT-2 Fan Status
WDA	CHP Plant DA Control Power
FWH4	CHP Plant Flow Rate H-4
FG	CHP Plant Gas Flow
FG_ACC	CHP Plant Gas Meter
TLW	CHP Plant LW Temp TE-601
FST	CHP Plant Main Header
PST	CHP Plant Main Header Pressure
SCHW1	CHP Plant P-CHW-1 Status
SCHW2	CHP Plant P-CHW-2 Status
FSP	CHP Plant Plant Header
PSP	CHP Plant SC Pressure

CDH ID	TBS Server ID
SFSC1	CHP Plant SC-1 Fan Status
SFSC2	CHP Plant SC-2 Fan Status
SFSC3	CHP Plant SC-3 Fan Status
FSM	CHP Plant Steam Flow
FSM1	CHP Plant Steam Flow S-1
WG1	Cogen 1 Energy
WG1_KW	Cogen 1 Power
PF1	Cogen 1 Power Factor
WG2	Cogen 2 Energy
WG2_KW	Cogen 2 Power
PF2	Cogen 2 Power Factor
WG3	Cogen 3 Energy
WG3_KW	Cogen 3 Power
PF3	Cogen 3 Power Factor
WGB	Genbus Energy
WGB_KW	Genbus Power
PFGB	Genbus Power Factor
TE607	Hosp 2F HX-5 Pri EW TE-607
TE608	Hosp 2F HX-5 Pri LW TE-608
SH25PP	Hosp 2F HX-5 Pri Pump Status
TE609	Hosp 2F HX-5 Sec EW TE-609
TE610	Hosp 2F HX-5 Sec LW TE-610
SH25SP	Hosp 2F HX-5 Sec Pump Status
TE611	Hosp 5F HX-6 Pri EW TE-611
TE612	Hosp 5F HX-6 Pri LW TE-612
SH56PP	Hosp 5F HX-6 Pri Pump Status
TE613	Hosp 5F HX-6 Sec EW TE-613
TE614	Hosp 5F HX-6 Sec LW TE-614
SH56PP	Hosp 5F HX-6 Sec Pump Status
TE615	Hosp 5F HX-7 Pri EW TE-615
TE616	Hosp 5F HX-7 Pri LW TE-616
SH57PP	Hosp 5F HX-7 Pri Pump Status
TE617	Hosp 5F HX-7 Sec EW TE-617
TE618	Hosp 5F HX-7 Sec LW TE-618
SH57SP	Hosp 5F HX-7 Sec Pump Status
TE603	Hosp Bm HX-4 Pri EW TE-603
TE604	Hosp Bm HX-4 Pri LW TE-604
TE605	Hosp Bm HX-4 Sec EW TE-605
TE606	Hosp Bm HX-4 Sec LW TE-606
TCHWE	Hosp CH-3 CHW Ent Temp TE-621
FCHW	Hosp CH-3 CHW Flow Rate
TCHWL	Hosp CH-3 CHW Lvg Temp TE-622
TCONE	Hosp CH-3 Cond Ent Temp TE-623
TCONL	Hosp CH-3 Cond Lvg Temp TE-624
THWE	Hosp CH-3 HW Ent Temp TE-619
THWL	Hosp CH-3 HW Lvg Temp TE-620
SCDP	Hosp CH-3 P-CDP-1 Status
SCHW	Hosp CH-3 P-CHW-3 Status
SCWP	Hosp CH-3 P-CWP-1 Status
WH	Hospital Energy
WH_KW	Hospital Power
PFH	Hospital Power Factor
WT1	Utility 1 Energy
WT1_KW	Utility 1 Power
PFT1	Utility 1 Power Factor
WT2	Utility 2 Energy
WT1_KW	Utility 2 Power
PFT2	Utility 2 Power Factor
SGD1	CHP CG-1 Fisher Valve
SGD2	CHP CG-2 Fisher Valve
SGD3	CHP CG-3 Fisher Valve
TE602	CHP Plant EW Temp TE-602

Site Notes:

4/24/2012: Data has been posted on NYSERDA CHP website