## *Allied Frozen Storage Site - Data Integrator Notes*

Allied Food Services provides frozen food storage and warehousing services for a variety of customers. The three AFS facilities provide for approximately 9.8 million cubic feet of frozen storage area. In addition there is 600,000 square feet of heated storage areas.

Currently the electrical demand varies seasonally from 1,450 kW to 1,660 kW and usage varies seasonally from 600,000 kWH to 900,000 kWH. Electrical load for the facility is primarily from refrigeration compressors plus some miscellaneous lighting and equipment. Presently electrical service is provided by Niagara Mohawk with 3 separate services, one at each building. The new configuration will consolidate the service to one location.

## Data Point Details

UET Controls logs data at 15-minute intervals. The data is uploaded to the CDH energy server every night. It is then downloaded from the server and processed. The data is then 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 Generator Output comes from the channel "WG". This data has units of kW and is converted to kWh for each interval. The resulting 15-minute interval energy data is summed into hourly data.

DG/CHP Generator Output Demand (peak kW)
The Generator Output Demand comes from the channel "WG". The maximum for each hourly period is used as the demand from the generator.

DG/CHP Generator Gas Input (cubic feet)
The data for Generator Gas Input comes from the channel "FG". This data is provided in units of btu/h and is converted Standard cubic feet per interval (using lower heating value, 930 btu/cf). The resulting 15 minute interval data is summed across the hour.

Total Facility Purchased Energy (total kWh)
The Total Facility Purchased Energy comes from the channels "WT" and "WT_EX". This data is provided in units of kW and converted to kWh. The export is subtracted from the import allowing a negative value to be displayed on the website when the facility is exporting power. This 15-minute interval energy data is summed into hourly data.

Total Facility Purchased Demand (peak kW)
The Total Facility Purchased Demand comes from the channels "WT" and "WT_EX". This data is provided in units of kW. The export is subtracted from the import allowing a negative value to

be displayed on the website when the facility is exporting power. The maximum for each hourly period is used as the demand from the generator.

Other Facility Gas Use (cubic feet)
Other Facility Gas Use comes from the channel "QEX" and represents the stack gas utilization. The data is given in btu/h and converted to cf. The data is then summed across the hour.

Unused Heat Recovery (total MBtu/h)
There is no data for this point.

Useful Heat Recovery (total MBtu/h)
The Useful heat Recovery is obtained from the channels "QH", "QCH", and "QL". The data is provided in units of btu/h and are converted to MBtu/h. The data is then summed between all three channels and averaged across each hour.

Status/Runtime of DG/CHP Generator (hrs)
The generator is defined as being fully on for a 15-minute interval if the generator output is greater than 400 kW (the fully-loaded capacity is 2500 kW but the usual operating level is 1250 kW). When this condition is true, the status is given a value of 1 for the interval. The 15-minute data is then averaged into hourly data for the online database.

Ambient Temperature (avg °F)
The Ambient temperature comes from the Weather Underground using the ROC airport as a reference location. The 15-minute data is averaged into hourly data.

Electrical Efficiency (%)
The Electrical Efficiency is calculated by dividing Generator Output (WG) in BTU's by Generator Gas Input (FGE) in BTU's. The lower heating value of natural gas used is 930 btu/cf. The expected efficiency should range from 27%-37%.

Total CHP Efficiency (%)
The Total CHP Efficiency is calculated by dividing the Generator Output and Useful Heat Recovery by the Generator Gas Input. The lower heating value of natural gas used is 930 btu/cf and the expected efficiency should range 75-90%

## *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 > 200 and FGE<=0 | DQ Level for FG 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 | 7500 cf | 0 cf |
| Total Facility Purchased Energy | Sum | 1000 kWh | -750 kWh |
| Total Facility Purchased Demand | Maximum | 4000 kW | -3000 kW |
| Other Facility Gas Use | Sum | 7500 cf | 0 cf |
| Unused Heat Recovery | Sum | - | - |
| Useful Heat Recovery | Sum | 20000 MBtu | 0 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. Relationship between CDH Tags and File Headers**

| CDH Tag | File Header |
|---|---|
| TAO2 | Outside Temperature (°F) |
| FG | Total Fuel (BTU/Hr) |
| WG | Gen Output (KVA) |
| QL | Low Temp (BTU/Hr) |
| QH | High Temp (BTU/Hr) |
| QCH | Chiller Hot Water (BTU/Hr) |
| QEX | Stack Gas Utilization (BTU/Hr) |
| CHP_EFF | Total Plant Eff (%) |
| TAO | Outside Database Temperature |
| WT | Utility Import (KW) |
| WT_EX | Utility Export (KW) |

## Site Notes:

11/10/2011:
Data has been posted to the website. Of the three channels providing data regarding useful heat recovery, only one channel is non-zero. In March 2011, an issue arises with the reading from the gas meter being to high and not matching the profile of power generation. Occasionally, the gas meter reading will drop to an appropriate value.