Penn Power Load Profile Application

I.   General

The Company presents the raw equations utilized in process of determining customer hourly loads. These equations may be utilized by Electric Generation Suppliers for a variety of reasons but are explicitly used by the Company in determining Hourly Energy Obligations submitted to PJM.

Below are instructions for the application of Penn Power's load profiles. Generally, non-interval metered customers are assigned one of the profiles described in this document. If a customer is interval metered, the customer will have a unique profile based upon 12 months of historical metered usage. Until an interval metered customer has 12 months of its historical metered usage, the customer will be assigned a profile described herein until 12 months of actual meter data is available to generate a customer profile.

The profiles below do not indicate a customer's load by themselves. They are a means to index and shape a customers load to their actual usage over the billing cycle desired.

II.   Select the Load Profile associated with each customer record.

A. Residential Customers

   i.   Identify the customer's assigned load profile(s) from the Sync List.

   ii. Customers on Residential Rate schedules will generally be assigned to one or more of the following load profile classifications. (Note – The labels shown below are for identification purposes and in some cases may not be descriptive of the Customer's Rate Schedule or use.)

        Profile RS Residential Summer Intensive
        Profile RG Residential General
        Profile RH Residential Heating

B. Commercial and Industrial Customers

   i.   Identify the customer's assigned load profiles(s) from the Sync List.

   ii. Customers on General Service, Commercial and Industrial Rate Schedules will generally be assigned to one of the following load profiles classifications. (Note – The labels shown below are for

identification purposes and in some cases may not be descriptive of the Customer's Rate Schedule or use.)

Profile CS Commercial and Industrial Summer Intensive
Profile CG Commercial and Industrial General
Profile C1 Commercial and Industrial – Load Factor Cluster 1
Profile C2 Commercial and Industrial – Load Factor Cluster 2
Profile C3 Commercial and Industrial – Load Factor Cluster 3
Profile CH Commercial and Industrial – High Load Factor Group

C. <u>Outdoor Lighting and Flat Load Customer Records</u>

i. Identify the customer's assigned load profiles(s) from the Sync List.

ii. Customers' records that identified with Street Lighting service, Private Outdoor Lighting Services or other metered or unmetered service associated with levels of available daylight will generally be assigned to the SL or TL profile. Customers' records that are identified with Traffic Lighting service or any other service characterized by an essentially flat load pattern will generally be assigned to the TL profile.

Profile SL Street Lighting and other light sensitive use
Profile TL Traffic Lighting and other flat use

III. <u>Select the appropriate Season respective to the selected market day and load profile classification. (Winter, Spring, Summer, Fall).</u>

A. <u>Residential, Commercial and Industrial Customers</u>

For the Residential, Commercial and Industrial groups each profile is divided into four seasons defined as Winter (December 16th to March 15th), Spring (March 16th to June 15th), Summer June 16th to September 15th) and Fall (September 16th to December 15th.

B. Outdoor Lighting and Flat Load Customer Records

The Street Light (SL) profile is not differentiated by Season, but by month only. The same profile is used for each day in a given month. Select the appropriate load profile based upon the month of the year.

The Traffic Lighting (TL) load profile is not differentiated by Season or by month. The same profile is used for each day in the year.

Select the Day-Type respective to the selected market day and load profile classification (Weekday, Saturday or Sunday/Holiday)

C. Residential, Commercial and Industrial Customers

For the Residential, Commercial and Industrial groups each profile is further divided within each season in three Day-Types.

> Weekdays (Mondays through Fridays, exclusive of defined Holidays)
> Saturdays,
> Sundays and Holidays

The defined Holidays use the same profiles as Sundays. The Holidays are New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. Note, this method does not follow NERC holiday or PJM Holiday schedules.

D. Outdoor Lighting and Flat Load Customer Records

The Street Light (SL) load profile is not differentiated by Day-Type, but by month only. The same profile is used for each day in a given month, and the values in the profile are equal to the "Percent On" for the hour. Thus, if the load is profiled to be on for the entire hour the index value is 100% or 1.0. Select the appropriate load profile based upon the month of the year.

The Traffic Lighting (TL) load profile is not differentiated by Day-Type or by month. The values in the profile are equal to the "Percent On" for the hour which is assumed to be 100% or 1.0 for every hour. The same profile is used for each day in the year.

This profile is further not affected by Holidays and does not change due to an operating day falling on a Holiday.

IV. Select the hourly Weather Response Function for each hour of the selected market day to be developed.

A. Residential, Commercial and Industrial Customers

For the Residential, Commercial and Industrial groups, within each Season and Day-type grouping, each profile is computed using Weather Response Functions (WRFs). The single or set of Weather Response Functions correspond to each hour of a given day. For each hour (within each Season and Day-type grouping) either one, two or three Weather Response Functions are available. Where more than one is available it is necessary to choose among the available WRFs basing the choice on the average temperature for the hour, as shown on the tables of load profiles that can be downloaded from the Company's website. The temperature range to which each WRF applies is also shown on those tables of load profiles; for convenience, the temperature ranges are also presented there in machine readable format (numeric low-end and high-end values for each temperature range). Where temperature ranges overlap, it is appropriate to use either equation to determine the customer hourly load for that hour.

Hourly Temperature data to be employed are the temperatures recorded by the National Weather Service at the following weather stations:

Pittsburgh International Airport

B. Outdoor Lighting and Flat Load Customer Records

Weather Response Functions are not used for the Street Light (SL) or Traffic Lighting (TL) load profiles. These loads do not vary with changes in weather.

V. Apply the appropriate Weather Response Function to each hour of the respective day type load profile for the selected market day.

A. Residential, Commercial and Industrial Customers

For the Residential, Commercial and Industrial groups, within each Season and Day-type grouping, each profile is computed using 24 Weather Response Functions (WRFs). Each hourly Weather Response Function is of the form:

$$y = mx + b$$

where   y = computed profile index value for the hour

m = a coefficient from the tables of Weather Response Functions representing the slope of the Weather Response Function

x = the temperature for the hour (in º F), using data from the same weather station described in the previous section, and

b = a constant from the tables of Weather Response Functions representing the y-intercept of the WRF

The coefficients (m) and constants (b) for each Weather Response Function – as well as the temperature range to which each WRF applies – are shown on the tables of load profiles that can be downloaded from the web site.

Application of the appropriately selected y = mx + b Weather Response Functions will produce a series of 24 index values for the 24 hours of the day. These constitute the daily profile for the selected market day for each profile class.

B. Outdoor Lighting and Flat Load Customer Records

Weather Response Functions are not used for the Street Light (SL) or Traffic Lighting (TL) load profiles.

VI. Constructing a monthly load profile

A. Residential, Commercial and Industrial Customers

For the Residential, Commercial and Industrial groups, the procedures outlined in the above steps produce a series of daily load profiles, one for each of the days that constitute the month (or billing cycle) for which a profile is to be constructed. These daily profiles will have been generated using the specific season and day-type that is applicable to each day, as well as the temperature (º F) for each hour in the day. Construction of a monthly profile is achieved by simply concatenating the daily profiles together in the proper chronological sequence. Thus, a monthly profile for a 31-day period would consist 744 (31 x 24) hourly index values.

B. Outdoor Lighting and Flat Load Customer Records

Monthly load profiles for the Street Light (SL) or Traffic Lighting (TL) customer records are also developed by concatenating together the appropriate daily profiles for the customer record. For Outdoor Lighting records, a monthly profile for a calendar month will consist of a series of identical load profiles. If the month to be profiled spans two calendar months, the proper number of daily profiles for each of the months will be concatenated in the appropriate chronological sequence. Since all Traffic Lighting daily profiles are the same (1= "On" for all hours) monthly profiles will simply be a string of the appropriate number of such daily profiles.

VII. **Applying a monthly load profile to a customer's kWh energy use – applies to all (Residential, Commercial, Industrial and Outdoor Lighting and Flat Load) Customer Records**

Monthly load profiles for a customer record are expressed as a series of index values, one for each hour of the month. These are not actual hourly kW values (kWh values) for the specific customer record. To convert the profile values to hourly kWh values it is necessary to ratio each of them up or down so that their sum matches the energy use (the number of kWh) measured at the customer location for a specific time period (or bill period). The ratio applied to each profile value is computed as:

$$\frac{\text{Actual customer kWh for the period}}{\text{Sum of respective class load profile index values for the same period}}$$

The result of multiplication of each profile number by this ratio produces a time series of hourly kW values (or kWh values) for the specific customer record.

This ratio is also referred to as the customer's Usage Factor.