Autumn 2009 CWV Review - Proposed Approach

Background:

The Uniform Network Code (Section H, Paragraph 1.4.2) requires Transporters every 5 years after consultation with DESC "to review and where appropriate revise with effect from the start of a gas year" composite weather variable (CWV) definitions for each LDZ. The last such CWV review was completed in autumn 2004 and implemented on 1st October 2005.

The next review will be concluded in autumn 2009 for implementation on 1st October 2010 and the revised CWVs will be used in the spring 2010 NDM analysis. This note describes in outline the proposed approach for this CWV review. The proposed approach is essentially the same as applied in the previous review undertaken in autumn 2004 with the addition of another 5 gas years of aggregate NDM demand and weather data.

Outline of Approach:

In the proposed approach, there are a number of stages involved in revising the CWV definition for a particular LDZ that use demand and weather data from a number of gas years. At each stage the values for one or more CWV parameter is estimated. For most of these stages, a range of possible values for the parameter(s) is investigated. Regression models are derived for each gas year relating daily demand to CWV (on some or all non-holiday days) for each of the possible CWV parameter values. The value(s) of the parameter(s) that produces the best fit of CWV to demand on average over the modelled gas years is chosen as the parameter estimate(s). If a particular gas year contains suspect demand or weather data, the demand model for that year may be excluded when selecting the best value(s) for the parameter estimate(s).

The stages involved in revising the CWV definition for a particular LDZ are described below:

1. Derive a pseudo SNET (an alternative seasonal profile) from aggregate NDM demand data using 3-frequency Fourier series. The pseudo SNET values are used in place of SNET values in the CWV formula. The parameters of the pseudo SNET are calculated from 13 years (1996/97 to 2008/09) autoregressive models of the form:

$$\mathrm{D} = a - \sum_{i=1}^{3} bi \sin\left(\frac{2id\pi}{365}\right) - \sum_{i=1}^{3} ci \cos\left(\frac{2id\pi}{365}\right) + d\mathrm{ET} + e\mathrm{WC} + f\mathrm{FRI} + g\mathrm{SAT} + h\mathrm{SUN} + \mu$$

   using non-holiday days (excluding 29th February) with ET_{min}<ET<ET_{max} where

   D=daily aggregate NDM demand,

   ET=daily effective temperature,

   WC=daily wind chill,

   d= day number (day 1=1st January etc.),

   FRI/SAT/SUN=1 if day is a Friday/Saturday/Sunday and 0 otherwise,

   μ= autoregressive error such that $\mu(t)= A^*\mu(t-1)+\varepsilon(t)$,

   A=autoregressive parameter.

   For each year's model, scale the *bi* and *ci* parameters by dividing by the sum of the Fourier series parameters (*b1*+*b2*+*b3*+*c1*+*c2*+*c3*). Take the mean of these 8 sets of scaled parameters to produce an average Fourier series. A "pseudo SNET" is derived from this average Fourier series by adding the mean ET and scaling the averaged parameters so that the pseudo SNET has a similar range and mean to the mean daily ET profile over the 13 years. The value for 29th February is derived from the average of the 28th February and March 1st values.

   Note that the limits ET_{min} and ET_{max} are integers that vary by LDZ and are chosen to select most of the non-holiday days that do not fall within the cold weather upturn or warm weather flattening off periods. Initial estimates of these limits are obtained from inspection of graphs of demand against composite weather (CW). Example initial estimates for ET_{min} and ET_{max} are 3 and 14 respectively.

2. Derive I_1 and I_2 parameter estimates using aggregate NDM demand data, pseudo SNET, ET and WC data from 1996/97 to 2008/09 (all non-holiday days with ET_{min}<ET<ET_{max}).

3. Derive initial estimates of *cold weather parameters* (V_0 and I_3) using demand and weather data from 1981/82 onwards (all non-holiday days with ET<ET_{max}). The demand data comprises maximum potential demand (MPD) data for gas years 1981/82 to 1995/96 and aggregate NDM data from 1996/97 to 2008/09.

4. Derive warm weather parameters (V_1, V_2 and q) using aggregate NDM demand data and weather data from 1996/97 to 2008/09 (Monday to Thursday non-holiday days).

5. Derive final estimates of cold weather parameters (V_0 and I_3) using demand and weather data from 1981/82 onwards (all non-holiday days). The demand data comprises MPD data for gas years 1981/82 to 1995/96 and aggregate NDM data from 1996/97 to 2008/09.

6. Derive the 1 in 20 peak CWV from all available weather data (81 gas years from 01/10/1928 to 30/09/2009) and estimate indicative 1 in 20 peak demands for each gas year from Monday to Thursday demand model parameters. Compare the fit and indicative peak demands for the revised CWV with the existing CWV.

7. Repeat stages 1 to 6 using different values for ET_{min} and ET_{max} on either side of the initial estimates. Select the combination of ET_{min} and ET_{max} limits and associated pseudo SNET and CWV parameters that give the best fit of CWV to aggregate NDM demand on average over the 13 gas years. If two sets of pseudo SNET and CWV parameters give very similar fits, chose the set that results in the minimum change to the indicative 1 in 20 peak demand estimates. The revised CWV definition for the LDZ comprises the selected pseudo SNET and set of CWV parameters.