DESC Approach to derivation of new Seasonal Normal Basis for 1 October 2015 onwards

Document Control

Version	Date	Reason for Change
Draft version 0.1	22-Sep-14	Initial draft of proposed approach for DESC review
Final version 1.0	07-Nov-14	DESC approved approach document on 15th October 2014 Additional paragraph added to reflect DESC approval of agreed smoothing technique

DESC Approach to derivation of New Seasonal Normal Basis for use in UNC NDM Demand Estimation: 1st October 2015 to 30th September 2020

This document describes the process to be followed in order to revise the basis of the Seasonal Normal Composite Weather Variable (SNCWV). This process follows the completion of the review and where appropriate revision of the Composite Weather Variable (CWV) definitions.

Background

The legal obligations relating to this process are referenced in Uniform Network Code (UNC) Section H and the UNC Transition document Part IIC – Transition Rules.

UNC Section H 1.5.4 states "*the relevant Sub-committee will, at appropriate frequencies determined by it, after consultation with the Uniform Network Code Committee or any other relevant Sub-committee, review and where appropriate revise (with effect from the start of a Gas Year) the seasonal normal value of the Composite Weather Variable for an LDZ*".

UNC Section H 1.5.2 states "*the seasonal normal value of the Composite Weather Variable for an LDZ for a Day in any year will be determined by the relevant Sub-committee".*

In this instance, the relevant Sub-committee is the Demand Estimation Sub-Committee (DESC).

Following the implementation of UNC Modification 330 there is a requirement in Section H and the Transition document to develop a Weather Station Substitution Methodology (WSSM) and Climate Change Methodology (CCM) from a reputable meteorological services company. The WSSM represents a methodology which can be used in the event of a weather station change. One of the deliverables from this project was a set of historical weather observations for the gas industry weather stations. The CCM represents a methodology which can be used to adjust the WSSM historical weather observations to take into account climate change trends.

Seasonal Normal Review 2015

For this particular Seasonal Normal Review cycle (2013-14), the reputable meteorological services company selected to develop the CCM was the 'Met Office'. The Met Office delivered both a methodology document and a series of data outputs reflecting a set of technical requirements developed by DESC.

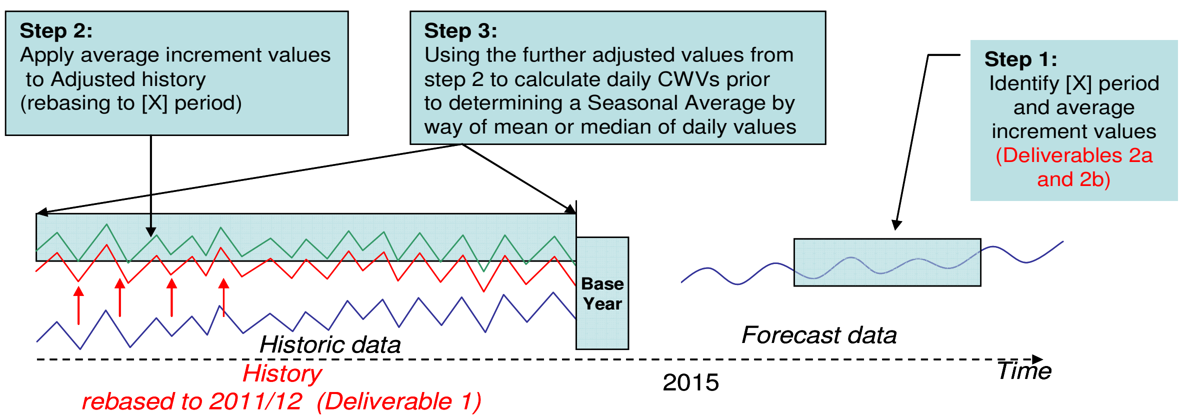
The final CCM document and associated data outputs signed off and approved by DESC are available to the industry via the secure Xoserve website – UK Link Documentation. The location is: 18.NDM Profiling and Capacity Estimation Algorithms / Climate Change Methodology.

To ensure the Met Office delivered a product that the gas industry were expecting and would be satisfied with, a sub group of industry experts from DESC (known as the 'Stakeholder Group') supported the development of the Methodology and datasets at various key points throughout the project.

In November 2013, the Stakeholder Group met with Xoserve to agree how the various outputs, due to be delivered by the Met Office, should be used when deriving the SNCWV. A high level process diagram (Fig. 1) was prepared and presented to DESC's Technical Workgroup on 27th November 2013 and it was also shared with DESC on 25th June 2014. This forms the foundation of the more detailed descriptions of how the SNCWV should be calculated which is explained in the next section.

Fig.1

Not to Scale, for illustration only



Deliverables:

1) *An adjusted view of historic hourly weather datasets (derived from WSSM) reflecting estimated impacts of climate change based on results from base year 2011/12*
2) *a) Predicted hourly climatological average values for period 1st October 2012 to 30th September 2025 based on predicted impact of climate change trends for future period*
   b) Predicted hourly increments values – difference between predicted hourly climatological average values (i.e. from 2a) and base year (2011/12) averages

Summary of DESC's Approach

One of the key principles of this approach is to ensure any industry party, who is a signatory of the Uniform Network Code, has the ability to replicate the calculations. This can be achieved because all of the data used in the process will be available on the secure area on Xoserve's website.

DESC's proposed approach for deriving the new seasonal normal basis (SNCWV) has been summarised as follows:

"Step 1: Identify [X] period and average increment values"

1.1 Following analysis of the Climate Change Methodology (CCM) projections for 4 Trial LDZs (SC, NE, WM and SW) a decision was made by the DESC Technical Workgroup at its meeting on 18th August 2014 to use a period of **5 years** to average the increment values. The 5 year period selected was 1st October 2015 to 30th September 2020.

The calculation of average hourly increments is only required for the Temperature weather variable. This is because, as explained in the CCM report, *"there is low confidence in the existence of any observed long-term trend in wind speed"* hence there are no associated increments for the Wind Speed weather variable to average.

1.2 For each of the gas industry weather stations retrieve the appropriate increments file for the Temperature weather variable. This file will be named as follows: 'Temperature_weatherstationID_increment_2012_2025.txt'.
Location: Folder 18 / Climate Change Methodology / 3.Final Datasets

1.3 All of the CCM outputs are stated in GMT and so should be converted to Local Time – Appendix 1 for more details

1.4 Selecting all records from the period 01/10/2015 00:00 to 30/09/2020 23:00 calculate the mean increment value for each hour for each calendar day, excluding any records associated to 29th February in the data series. The mean increment value should be rounded to 1 d.p.

1.5 Calculate the mean hourly increment value for 29th February by averaging the equivalent hourly values for 28th February and 1st March. The mean hourly increment value should be rounded to 1 d.p.

"Step 2: Apply average increment values to adjusted history (rebasing to [X] period)"

2.1 The values calculated in steps 1.4 and 1.5 represent the "*average increment values*" which need to be added to the adjusted history thus "*rebasing to [the average of the 5 year] period*". The adjusted history has been calculated by the Met Office and is provided as one of the CCM outputs.

2.2 For each of the gas industry weather stations retrieve the appropriate adjusted history file for the Temperature weather variable. This file will be named as follows: 'Temperature_weatherstationID_adjhist.txt' and contains hourly records from 01/01/1960 00:00 to 30/09/2012 23:00.
Location: Folder 18 / Climate Change Methodology / 3.Final Datasets

2.3 This file contains an adjusted view of the historic hourly weather datasets derived from the Weather Station Substitution Methodology (WSSM) phase, reflecting the estimated impacts of climate change based on results from the base year of 2011/12. As it was derived from the WSSM phase, those records where reliable estimates (as per the methodology) were not able to be calculated, will also be missing in the 'adjhist' file. As with the WSSM data these records are populated with a value of -32768.

The data in 'adjhist' will be used in the process of calculating the Composite Weather Variable history (Step 3), these missing records will need to be populated with a 'filled-in' value. An approach to infilling was signed off by TWG for use in the WSSM data series. It is proposed the same methodology is used for those records in the CCM data series. Details of the methodology can be viewed on the following link:

** Link to be added at a later date **

Only Temperature has been adjusted to account for a trend in the time series. For the remaining weather variables there was either no evidence in the scientific literature and/or the analysis to conclude that there was a trend due to climate change. For all variables apart from temperature, the adjusted time series (adjhist) are the same as the datasets for the Weather Station Substitution Methodology, except that columns 6 and 7 have been removed. This means for all weather variables other than temperature it will be possible to directly use the in-filled values from the WSSM data series. Missing records in the Temperature data series will need to be calculated using the agreed methodology.

2.4 Identify all records in the Temperature adjhist file where the value is -32768 and surrounding records. Apply methodology referenced in step 2.3 and update relevant records.

Note: Xoserve have performed these calculations and in the near future the revised data files will be published on the secure area of Xoserve's website.

Appendix 2 summarises the number of missing records by decade for each gas industry weather station where the methodology has been applied.

2.5 All of the CCM outputs are stated in GMT and so should be converted to Local Time - Appendix 4 for more details.

2.6 Add the appropriate mean hourly increment value (referenced in step 1.4) to all records in the updated 'adjhist' data series referenced in the previous step and round to 1 d.p. The resultant values will effectively have been 're-based' to reflect the 5 year average period of 1st October 2015 to 30th September 2020.

2.7 The Composite Weather Variable (CWV) calculation requires the adjhist Temperature data series (at the end of step 2.6) and the adjhist Wind Speed data series. As explained in step 1.1 there has been no climate change adjustment made to the adjhist Wind Speed data series, although an output from the Climate Change project has still been produced (Windspeed_weatherstationID_adjhist.txt).

2.8 For each of the gas industry weather stations retrieve the appropriate adjusted history file for the Wind Speed weather variable. This file will be named as follows: 'Windspeed_weatherstationID_adjhist.txt' and contains hourly records from 01/01/1960 00:00 to 30/09/2012 23:00.
Location: Folder 18 / Climate Change Methodology / 3.Final Datasets

2.9 As with the Temperature data series there will be records that are missing which again will be populated with a value of -32768. These records will need to be filled-in, as stated in step 2.3 these records can be filled in using the filled-in WSSM data series. Appendix 3 summarises the number of missing records by decade for each gas industry weather station where the methodology has been applied.

The location of the filled-in WSSM data series will be provided in the near future.

2.10 Once the 'In-filling' phase has been completed it should then be converted to Local Time - Appendix 4 for more details

2.11 Convert the wind speed values into knots (Met Office supplied CCM data in metres per second). Multiply value by 1.943844 and round to whole number.

This completes all of the activities necessary to prepare the CCM Temperature and Wind Speed data series ready for use in calculating daily CWVs in Step 3.

"Step 3: Using the further adjusted values from step 2 to calculate daily CWVs prior to determining a Seasonal Average by way of mean or median of daily values".

3.1 For each weather station a daily temperature and wind speed need to be derived. All daily temperatures and wind speeds are derived from within day values (2-hourly weighted for temperatures and the 4-hourly unweighted mean for wind speeds).

Note: Further to the future change in gas day arrangements expected from October 2015, DESC agreed on 30th July 2014 that the 2-hourly temperatures used to derive the daily temperature value should be based on 5am to 3am rather than the current 7am to 5am. The 4 hourly wind speed timeslots remain as-is.
Appendix 5 provides clarification on weightings for temperature and wind speed.

3.2 Apply the revised definitions of CWV to the ensuing computations. Note that CWV definitions are based on the fit of daily values of total LDZ NDM demand to daily values of weather (temperature and wind speed).

3.3 Calculate a CWV for each day in the period 1st October 1960 to 30th September 2012. Effectively this will result in 52 different versions of CWV for any given day in a gas year. Note: Create an Effective Temperature series from 1st January 1960 and use the Effective Temperature value on 30th September 1960 as the input to the CWV calculations from gas day 1st October 1960 onwards.

3.4 In order to create a single CWV value for each day in a 365 day year calculate the mean of each set of 52 separate CWV values. Note that 29th February is ignored in all calculations. The SNCWV for 29th February is later set to the average of the values of the two adjacent days.

3.5 This gives an unsmoothed daily average value of CWV adjusted for the predicted impacts of climate change for the period October 2015 to September 2020 for each day of a 365 day year.

The unsmoothed values alone will not be appropriate to use directly in the EUC modelling processes. A smoothing technique is therefore required to a) remove excessive day-to-day variation in the CWV profile b) ensure that the overall area under the curve is not altered (no additional warming or cooling introduced) and c) ensure retention of the kinks and bumps are evident in the visual inspection of the final smoothed profile.

DESC decided at its meeting on 15th October 2014 that a **5 day centred moving average** achieves all of the above objectives and ensures all industry parties are able to replicate the end to end SNCWV calculation.

3.6 Finally smooth the computed CWV profile using a 5 day centred moving average.

Annex

Appendix 1: (referenced in Step 1.3)

GMT to BST Correction Summary

Calendar Year	First 'Spring Correction' +1 @ 02:00 GMT	Final 'Autumn Correction' +1 @ 00:00 GMT
2015		25th October
2016	27th March	30th October
2017	26th March	29th October
2018	25th March	28th October
2019	31st March	27th October
2020	29th March	

Appendix 2: (referenced in Step 2.4)

Number of records in 'Temperature_weatherstationID_adjhist.txt' where in-filling methodology has been applied

Weather Station Name / ID	Period where missing records present (-32768)			
	1960s	1970s	1980s	Total
Glasgow Bishopton / 03134	2	6	3	11
Albermarle / 03238	457	1	-	458
Rostherne No.2 / 03351	190	179	125	494
Nottingham Watnall / 03354	11	-	-	11
Winterbourne No.2 / 99062	42	11	5	58
St.Athan / 03716	241	17	4	262
London Heathrow / 03772	-	-	-	0
Southampton / 99079	11,702	5,840	-	17,542
Filton / 03628	30	-	-	30

Appendix 3: (referenced in Step 2.9)

Number of records in 'Windspeed_weatherstationID_adjhist.txt' where in-filling methodology has been applied.

Weather Station Name / ID	Period where missing records present (-32768)					
	1960s	1970s	1980s	1990s	2000s	Total
Glasgow Bishopton / 03134	-	1027	1	1	1	1030
Albermarle / 03238	473	1	1	3	2	480
Rostherne No.2 / 03351	-	-	1	3	7	11
Nottingham Watnall / 03354	2	-	-	-	-	2
Coleshill / 03535	-	-	1	-	-	1
St.Athan / 03716	-	-	1	-	-	1
London Heathrow / 03772	-	-	-	-	-	0
Southampton / 99079	-	-	-	3	-	3
Filton / 03628	2	-	1	1	-	4

Appendix 4: (referenced in Steps 2.5 and 2.10)

GMT to BST Correction Summary

Calendar Year	1^{st} Spring Correction +1 @ 02:00 GMT	Final Autumn Correction +1 ‘ 00:00 GMT
1960	27^{th} March	30^{th} October
1961	26^{th} March	29^{th} October
1962	25^{th} March	28^{th} October
1963	31^{st} March	27^{th} October
1964	29^{th} March	25^{th} October
1965	28^{th} March	31^{st} October
1966	27^{th} March	30^{th} October
1967	26^{th} March	29^{th} October
1968	31^{st} March	27^{th} October
1969	30^{th} March	26^{th} October
1970	29^{th} March	25^{th} October
1971	28^{th} March	31^{st} October
1972	26^{th} March	29^{th} October
1973	25^{th} March	28^{th} October
1974	31^{st} March	27^{th} October
1975	30^{th} March	26^{th} October
1976	28^{th} March	31^{st} October
1977	27^{th} March	30^{th} October
1978	26^{th} March	29^{th} October
1979	25^{th} March	28^{th} October
1980	30^{th} March	26^{th} October
1981	29^{th} March	25^{th} October
1982	28^{th} March	31^{st} October
1983	27^{th} March	30^{th} October
1984	25^{th} March	28^{th} October
1985	31^{st} March	27^{th} October
1986	30^{th} March	26^{th} October
1987	29^{th} March	25^{th} October
1988	27^{th} March	30^{th} October
1989	26^{th} March	29^{th} October
1990	25^{th} March	28^{th} October
1991	31^{st} March	27^{th} October
1992	29^{th} March	25^{th} October
1993	28^{th} March	31^{st} October
1994	27^{th} March	30^{th} October
1995	26^{th} March	29^{th} October
1996	31^{st} March	27^{th} October
1997	30^{th} March	26^{th} October
1998	29^{th} March	25^{th} October
1999	28^{th} March	31^{st} October
2000	26^{th} March	29^{th} October
2001	25^{th} March	28^{th} October
2002	31^{st} March	27^{th} October
2003	30^{th} March	26^{th} October
2004	28^{th} March	31^{st} October
2005	27^{th} March	30^{th} October
2006	26^{th} March	29^{th} October
2007	25^{th} March	28^{th} October
2008	30^{th} March	26^{th} October
2009	29^{th} March	25^{th} October
2010	28^{th} March	31^{st} October
2011	27^{th} March	30^{th} October
2012	25^{th} March	

Appendix 5: (referenced in Step 3.1)

Within day temperature and wind speed weightings

- **Temperature**

Actual temperatures (℃) are recorded every two hours. These two-hourly temperatures are weighted, to calculate the daily actual temperature for a gas day. The date of the gas day is that associated with the start of the gas day. The timings and weightings to be applied before and after the implementation of the change of Gas Day were agreed at DESC on 30/07/14 and are shown below.

Gas Years **up to** and including **2014/15** - Temperature		Gas Years **2015/16** and **onwards** - Temperature	
TIME	WEIGHT	TIME	WEIGHT
07:00	0.1	05:00	0.05
09:00	0.1	07:00	0.1
11:00	0.1	09:00	0.1
13:00	0.1	11:00	0.1
15:00	0.1	13:00	0.1
17:00	0.1	15:00	0.1
19:00	0.1	17:00	0.1
21:00	0.1	19:00	0.1
23:00	0.05	21:00	0.1
01:00	0.05	23:00	0.05
03:00	0.05	01:00	0.05
05:00	0.05	03:00	0.05

- **Wind Speed**

Actual wind speeds are recorded every four hours at the times shown below. A daily average wind speed is calculated from the unweighted mean of these four-hourly wind speeds:

Gas Years **up to** and including **2014/15** – Wind Speed	Gas Years **2015/16** and **onwards** – Wind Speed
07:00 11:00 15:00 19:00 23:00 03:00	07:00 11:00 15:00 19:00 23:00 03:00