

DEMAND OVERRIDE METHODOLOGY

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History

Version	Date	Changes	Author
1.1	7 June 2006	Operational Trial version	Peter Forretto
1.2	1 February 2007	New market version	Peter Forretto
3.0	15 July 2008	Changes to thresholds resulting from new Brooklyn Lara Pipeline, inclusive of other minor editorial updates.	Stewart Blandford
4.0	16 November 2009	AEMO Version	Luis Mayo
5.0	16 July 2013	Updates to thresholds, change weather categories to profile categories and general corrections	Luke Garland

1 Introduction

1.1 Purpose and Scope

This methodology describes the methodology used by AEMO for overriding Market Participants' total system Demand Forecast as required by the Wholesale Market Gas Scheduling Procedures.

1.2 Background

In the Victorian Declared Wholesale Gas Market (DWGM), Market Participants forecast demand, which is used by AEMO for gas scheduling subject to any Demand Override applied by AEMO. The Demand Override Methodology outlines AEMO's process in determining any total Demand Overrides.

Under the Demand Forecast Override Methodology, AEMO determines its own demand forecasts for uncontrollable demand, which is inclusive of site-specific demand forecasts, known as the AEMO Total Demand Forecast. Site-specific demand forecasts come directly from the site (e.g. a gas fired electricity generator).

As a key component of the scheduling process, AEMO will compare its forecast with the aggregate of the individual Market Participant demand forecasts (including site-specific demand forecasts). This is known as the Market Participant Demand Forecast. If the Market Participant Demand Forecast is too high or too low relative to the AEMO Total Demand Forecast, then an amount may be subtracted from (or added to) the Market Participant Forecast Demand to create the Total Demand, so as to ensure that an appropriate amount of gas is scheduled to maintain a safe level of linepack reserve and subsequently system security. This amount is called the Demand Override. In the absence of a Demand Override, the Market Participant Forecast Demand is the Total Demand.

Even if the Market Participant Demand Forecast over a day is in close agreement with the AEMO Total Demand Forecast, AEMO may still need to use Demand Overrides for individual hours without overriding the Total Demand for the gas day in order to account for a demand profile discrepancy, where System Security issues are apparent.

The criteria that AEMO applies to determine if it has to override the Market Participant Forecast Demand reflect:

- the difference between AEMO's Total Demand Forecast and the Market Participant Demand Forecast's for the day (or in any given hour),
- AEMO's expectations of the ability of the system at that time to withstand deviations from (forecast) schedule without creating an unacceptable risk of involuntary curtailment.

1.3 Definitions

Table 1 Abbreviations and Symbols

Abbreviation	Term
BOD	beginning-of-day
EST	Eastern Standard Time
DTS	Declared Transmission System
DWGM	Declared Wholesale Gas Market
MP	Market Participant
NGR	National Gas Rules
WMGSP	<i>Wholesale Market Gas Scheduling Procedures</i> (AEMO publication)

Table 2 Defined Terms

Term	Definition
AEMO Total Demand Forecast	AEMO's gas demand forecast for uncontrollable demand
Market Participant Demand Forecast	Aggregate of all individual Market Participants' gas demand forecasts.
Demand Override	Quantity added to or subtracted from Market Participant Demand Forecast to create the Total Demand.
Demand Override Threshold	Boundaries of tolerable forecast deviation used to determine the quantity of any Demand Override.
Total Demand	Final Total Demand Forecast used in scheduling process by AEMO.
Uncontrollable Demand	System demand and site specific demand combined

2 Overview

One of AEMO's objectives is to operate the Declared Transmission System (DTS) in a secure state, as required in the Wholesale Market System Security Procedures. This is achieved when, amongst other things, the effects of any unplanned events can be controlled by operational responses.

Operating in a secure state achieves system security, and in this context, means effectively dealing with likely gas transportation constraints over the day, preventing over and under pressure events and maintaining curtailment risk at acceptable levels. The objective of overriding Market Participants' Demand Forecasts is to maintain an acceptable level of risk for System Security based on AEMO's Total Demand Forecast. Such overrides are employed according to the Demand Override Threshold levels, which are dependent upon forecast uncertainty and will vary according to:

- Time of day
- The AEMO Total Demand Forecast
- The Total Demand Profile which will take into account large hourly demand increases (e.g. gas fired power generator demand)
- BOD linepack levels
- Weather conditions (e.g. severe evening demand profile)

As a Gas Day progresses, the forecast demand becomes more certain as a clearer picture of the weather conditions, gas usage and ultimately Total Demand is apparent. The Demand Override Threshold then should essentially be the maximum deviation from the actual demand at a given point in time that is tolerable without causing a threat to System Security under the current transmission capabilities. It should also follow that the level of tolerability will decrease as the day progresses, due to the better understanding of the actual demand and the approach to the peak gas usage period. The interaction between Forecast Demand uncertainty levels and forecast uncertainty are best demonstrated conceptually, and can be seen in Figure 1, where uncertainty is reduced as the day progresses.

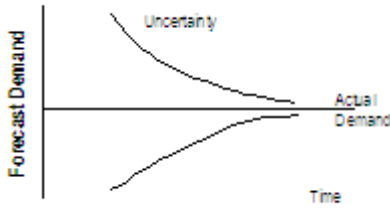


Figure 1 – Demand Override Threshold

As can be seen from Figure 1, the uncertainty decreases with time, and the Demand Override Thresholds are designed to mirror the maximum acceptable deviation of the uncertainty that the system can handle at a given point, and is thus the reason the thresholds typically decrease with time. The level of gas demand expected will also impact these thresholds, tightening them with increased demand, as there is less capacity for the system to handle deviation than is possible on a low gas demand day.

Looking at the uncertainty levels at a particular point in time, Figure 2 and Figure 3 illustrates the uncertainty levels at 6AM and 2PM relative to a given demand forecast. Taking the AEMO Total Demand Forecast as the mean of the distribution, the further the Market Participants Demand Forecast deviates from this, the more likely that the Market Participants Demand Forecast is incorrect and will need a Demand Override.

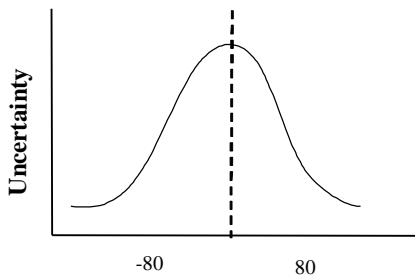


Figure 2 - 6AM Uncertainty Distribution

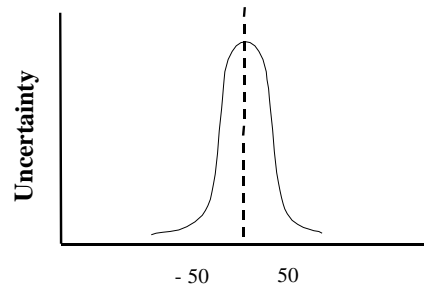


Figure 3 - 2PM Uncertainty Distribution

Figure 4 below illustrates the skewed effect resulting from a low BOD linepack. The maximum tolerable uncertainty that can be allowed to maintain System Security due to pressure considerations is clearly reduced on the negative side, and the Demand Override Thresholds are thus influenced by BOD linepack considerations.

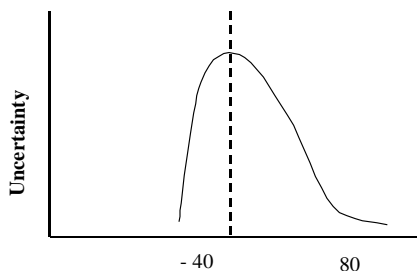


Figure 4 - 6AM Threshold Level for 50 TJ low BOD Linepack

The rationale of this approach is that if participants continue to under forecast without the influence of linepack adjusting the Thresholds, the likelihood of depleting linepack reserve to low levels increases. This in turn increases the need for peak shaving gas. This may require a greater ‘override’ quantity to be applied by AEMO via an ad hoc schedule to maintain system security during the peak period. The opposite effect is also present with over forecasting, which can threaten maximum pressure requirements within the DTS.

The final factor in determining the threshold is the Total Demand Profile itself. For example, Figure 5 shows two differing demand profiles from real days with exactly the same system demand but experiencing significantly different peaks and linepack minimums. The deviation of system demand away from the injections over the first 16 hours of the day determines what minimum system linepack will be experienced during the evening peak.

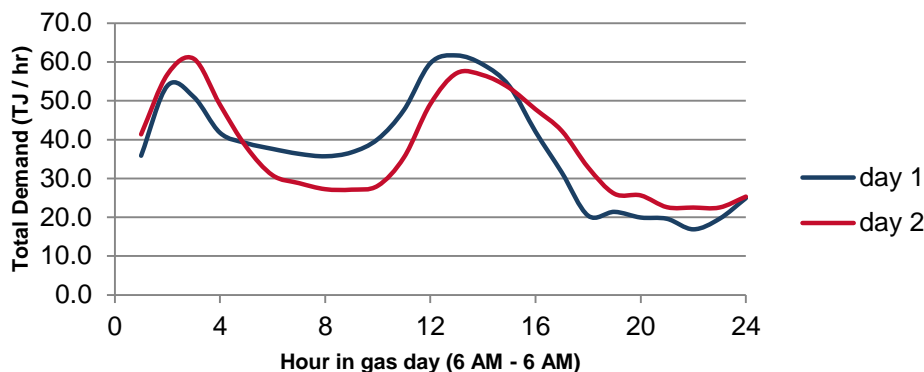


Figure 5 - Total Demand Profile Comparison

Any day which has a difference between the demand and injections in the first 16 hours greater than two standard deviations above the average is considered a peak day and hence will experience a lower linepack minimum after evening peak. Any day which has a difference between the total demand and injections in the first 16 hours less than two standard deviations below the average is considered a flat profile day and hence will experience a higher linepack minimum after evening peak.

In performing an override, AEMO will override only by an amount that brings the aggregate market participant forecast demand within AEMO's forecast uncertainty distribution. For example, if the trigger level of -60 TJ is breached by an aggregate market participant forecast deviation of -80 TJ from AEMO's forecast, then AEMO would only override by $+20$ TJ to bring the forecast within tolerability levels. Refer to the sample calculations in Appendix 1 for further illustration.

3 Principle for Setting a Demand Override

The need for a demand override usually arises because of either forecast likelihood of low pressures or high pressures, typically, but not limited to, peak gas usage periods. What follows are the key considerations used in determining if a Market Participant Demand Forecast requires a Demand Override. Specifically, this entails "ideal" demand override thresholds, profile categories, BOD linepack levels and demand override threshold adjustment factors.

3.1 Demand override threshold

Table 5 has been developed by considering 'average' operating conditions on any gas day type (i.e. there is no differentiation between a Monday and Saturday), and the most probable tolerance of any forecast uncertainty for each scheduling horizon under current DTS capabilities. Thus the AEMO Demand Override Thresholds are based on an average demand level, a target BOD linepack level and average weather conditions.

These thresholds may be adjusted subject to the forecast demand level, profile category and BOD linepack level.

The values in the Upper Limit row are applied in the calculation of threshold override, when MP's demand forecast is greater than AEMO's, and the values in the Lower Limit row are applied when MP's demand forecast is smaller than AEMO's.

Table 5 Demand override threshold limits

	6:00 AM	10:00 AM	2:00 PM	6:00 PM	10:00 PM
Upper Limit	110 TJ	90 TJ	70 TJ	50 TJ	30 TJ
Lower Limit	180 TJ	120 TJ	80 TJ	40 TJ	40 TJ

3.2 Profile categories

Table 6 has been developed considering the impact of the Total Demand Profile on System Security. The following equation is used to calculate a Profile value which is essentially an indication of minimum linepack levels that are expected to occur during the evening peak. This profile value is then used with Table 7, 8 and 9 to determine a factor which will be applied to the threshold.

$$\text{Profile Value (TJ)} = \sum_{n=1}^{16}(\text{Total Hourly Withdrawal}) - \sum_{n=1}^{16}(\text{Total Hourly Injection})$$

If the profile is greater than a certain value as shown in Table 6 then the profile is considered to be a Heavy demand profile. If the profile is less than a certain value as shown in Table 6, then the profile is considered to be a Light demand profile. Any value in-between these two values is considered an Average demand profile.

Table 6 Profile Categories

AEMO total forecast demand	AEMO Profile Type		
	Light profile if less than	Average Profile	Heavy profile if greater than
Total Demand < 630 TJ/d	5	5<value<65	65
Total demand >= 630 TJ/d and < 930 TJ/d	45	45<value<120	120
Total demand >= 930 TJ/d and < 1,030 TJ/d	90	90<value<145	145
Total demand >= 1,030 TJ/d and < 1,080 TJ/d	105	105<value<160	160
Total demand >= 1,080 TJ/d and < 1,130 TJ/d	110	110<value<160	160
Total demand >= 1,130 TJ/d and < 1,180 TJ/d	125	125<value<170	170
Total demand >= 1,180 TJ/d	135	135<value<170	170

3.3 Beginning of day linepack level

Table 7 has been developed considering the impact of the BOD linepack levels on System Security. These will be used, alongside the profile categories, to adjust the Demand Override Thresholds.

Table 7 Beginning of day linepack levels

	BoD linepack level	
High BOD Linepack	BOD Linepack deviation > + 20 TJ from target.	High BOD Linepack
On target Linepack	BOD Linepack deviation within \pm 20 TJ of target.	On target Linepack
Low BOD Linepack	BOD Linepack deviation < - 20 TJ from target.	Low BOD Linepack

3.4 Adjustment to Demand Override Thresholds

Table 8 and Table 9 have been developed to consider the combined impact of the AEMO forecast demand levels, the profile categories and BOD linepack levels. The combination of these considerations creates an adjustment factor that is used to adjust the Demand Override Threshold found in Table 8 and 9. Table 8 displays the upper limit adjustment factors and Table 9 shows the lower limit adjustment factors.

Table 8 Demand forecast upper limit adjustment factor

		Upper Limit Adjustment Factor		
AEMO total forecast demand	BOD linepack level	Profile Category		
		Light	Average	Heavy
Total Demand < 630 TJ/d	High BOD Linepack	0.8	0.8	0.8
	On target	0.8	0.9	1
	Low BOD Linepack	1	1	1
Total demand \geq 630 TJ/d and < 930 TJ/d	High BOD Linepack	0.8	0.8	0.9
	On target	0.9	1	1
	Low BOD Linepack	1	1	1
Total demand \geq 930 TJ/d and < 1,030 TJ/d	High BOD Linepack	0.8	0.9	1
	On target	1	1	1
	Low BOD Linepack	1	1	1
Total demand \geq 1,030 TJ/d and < 1,080 TJ/d	High BOD Linepack	0.9	1	1
	On target	1	1	1
	Low BOD Linepack	1	1	1
Total demand \geq 1,080 TJ/d and < 1,130 TJ/d	High BOD Linepack	1	1	1
	On target	1	1	1
	Low BOD Linepack	1	1	1
Total demand \geq 1,130 TJ/d and < 1,180 TJ/d	High BOD Linepack	1	1	1
	On target	1	1	1
	Low BOD Linepack	1	1	1
Total demand \geq 1,180 TJ/d	High BOD Linepack	1	1	1
	On target	1	1	1
	Low BOD Linepack	1	1	1

Table 9 Demand forecast lower limit adjustment factor

AEMO total forecast demand		Lower Limit Adjustment Factor		
		Profile Category		
BOD linepack level		Light	Average	Heavy
Total Demand < 630 TJ/d	High BOD Linepack	1	1	0.8
	On target	1	0.9	0.7
	Low BOD Linepack	1	0.8	0.6
Total demand >= 630 TJ/d and < 930 TJ/d	High BOD Linepack	1	0.8	0.5
	On target	1	0.7	0.4
	Low BOD Linepack	1	0.5	0.3
Total demand >= 930 TJ/d and < 1,030 TJ/d	High BOD Linepack	0.8	0.5	0.3
	On target	0.7	0.4	0.2
	Low BOD Linepack	0.6	0.3	0.1
Total demand >= 1,030 TJ/d and < 1,080 TJ/d	High BOD Linepack	0.6	0.3	0.2
	On target	0.5	0.2	0.1
	Low BOD Linepack	0.4	0.1	0
Total demand >= 1,080 TJ/d and < 1,130 TJ/d	High BOD Linepack	0.3	0.2	0.1
	On target	0.2	0.1	0
	Low BOD Linepack	0.1	0	0
Total demand >= 1,130 TJ/d and < 1,180 TJ/d	High BOD Linepack	0.2	0.1	0
	On target	0.1	0	0
	Low BOD Linepack	0	0	0
Total demand >= 1,180 TJ/d	High BOD Linepack	0.1	0	0
	On target	0	0	0
	Low BOD Linepack	0	0	0

Note. Total Demand = Market Participant System Demand + Site-Specific Demand

Operationally, there are reduced concerns for a large under forecast in demand for low demand day, represented in Table 9 as Total Demand less than 630 TJ, regardless of Profile Category or BOD linepack levels. Conversely, for high demand days when there is greater likelihood of peak shaving requirement, the threshold is reduced depending on Total Demand levels in order to reduce likelihood of curtailment.

4 Process

4.1 Determining demand forecast process

The demand forecasting process used by AEMO is represented by Figure 6 below:

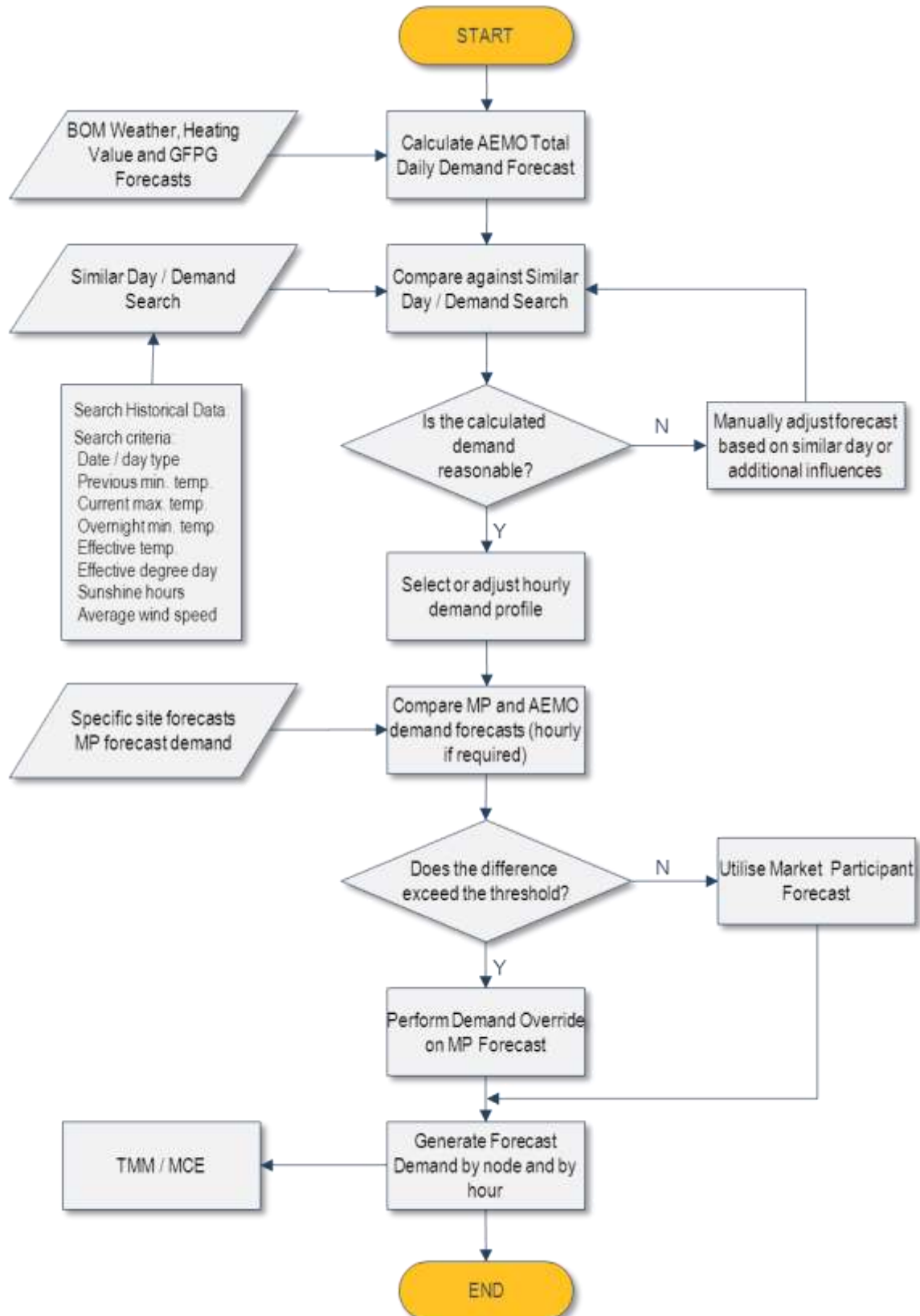


Figure 6 - Demand forecast process

4.2 Determining demand override quantity

What follows is the process followed by AEMO to determine any override quantities. For schedules with standard start times, AEMO will:

Process	
1. Determine upper limit threshold	<ul style="list-style-type: none"> Determine the BOD linepack level in Table 7 Determine the profile category based on Table 6. Select the appropriate AEMO forecast demand range in Table 8. Determine the upper limit adjustment factor in Table 8, based upon the profile category determined from Table 6 and the BOD linepack determined from Table 7. Multiply the "ideal" threshold from Table 5 by the upper limit adjustment factor from Table 8
2. Determine lower limit threshold	<ul style="list-style-type: none"> Determine the BOD linepack level in Table 7 Determine the profile category based on Table 6. Select the appropriate AEMO forecast demand range in Table 9. Determine the lower limit adjustment factor in Table 9, based upon the profile category determined from Table 6 and the BOD linepack determined from Table 7. Multiply the "ideal" threshold from Table 5 by the lower limit adjustment factor from Table 9.
3. Calculate the difference	<ul style="list-style-type: none"> Calculate the difference between Market Participant Demand Forecast and AEMO Demand Forecast
4. Compare Thresholds.	<ul style="list-style-type: none"> Compare calculated Thresholds against calculated difference between the forecasts. If the difference between these exceeds either the lower or upper threshold limits, override Market Participants Demand Forecast by an amount that will bring the Market Participants Demand Forecast in line to the outer limit of the threshold
5. Distribute Override quantity amount	<ul style="list-style-type: none"> Distribute Override quantity amount by hour into the remaining hours of the Gas Day. AEMO will distribute the amount in consideration of the hourly forecast demand deviation and possible effect on System Security actions <p>Note. For ad hoc schedules, the threshold will be determined at AEMO's sole discretion.</p>

5 Alterations to this methodology

Any changes to this methodology, if required, will be implemented in accordance with the AEMO change process in consultation with the Gas Wholesale Consultative Forum.

Appendix A Examples

Example 1

- June 2:00 PM horizon, BOD linepack = 27 TJ above target.
- AEMO Total Demand Forecast 985 TJ.
- MP Total Demand Forecast = 1,010 TJ
- Profile Value = 81 TJ

Process		
Determine Variables and Conditions	<ul style="list-style-type: none"> • Determine the BOD linepack level in Table 7 • Select the appropriate AEMO forecast demand range in Table 8. • Determine the profile factor based on Table 6. 	<ul style="list-style-type: none"> • 27 TJ, High BOD linepack • Range ≥ 930 TJ and $< 1,030$ TJ • Profile Value (TJ) = 81, which is Light
Determine appropriate limits threshold	<ul style="list-style-type: none"> • Determine the upper limit adjustment factor in Table 8 & "ideal" threshold from Table 5 • Multiply the "ideal" threshold from Table 5 by the upper limit adjustment factor from Table 8 	<ul style="list-style-type: none"> • Upper Factor = 0.8 • Upper "ideal" threshold = 70 TJ • $70 \text{ TJ} \times 0.8 = +56 \text{ TJ}$
Calculate the difference	<ul style="list-style-type: none"> • Calculate the difference between Market Participant Demand Forecast and AEMO Demand Forecast 	<ul style="list-style-type: none"> • Diff = $1,010 \text{ TJ} - 985 \text{ TJ} = 25 \text{ TJ}$
Compare Thresholds	<ul style="list-style-type: none"> • Compare calculated Thresholds against calculated difference between the forecasts. • If the difference between the two forecasts exceeds either the lower or upper threshold limits, override Market Participants Demand Forecast by an amount that will bring the Market Participants Demand Forecast in line to the outer limit of the threshold 	<ul style="list-style-type: none"> • Threshold = 56 TJ • Diff = 25 TJ • Difference does not exceed threshold hence there is no override • Override = 0 TJ
Produce Total Demand	<ul style="list-style-type: none"> • Calculate the Total Demand Forecast by adding or subtracting the Demand Override to the MP Demand Forecast 	<ul style="list-style-type: none"> • Total Demand = MP Demand Forecast + Demand Override • $= 1,010 \text{ TJ} + (0) \text{ TJ} = 1,010 \text{ TJ}$

Example 2

- July 10:00 AM horizon, BOD linepack = 9 TJ below target.
- AEMO Total Demand Forecast 986 TJ.
- MP Total Demand Forecast = 944 TJ
- Profile Value = 146 TJ

Process		
Determine Variables and Conditions	<ul style="list-style-type: none"> • Determine the BOD linepack level in Table 7 • Select the appropriate AEMO forecast demand range in Table 9. • Determine the profile factor based on Table 6. 	<ul style="list-style-type: none"> • -9 TJ, On Target BOD linepack • Range ≥ 930 TJ and < 1030 TJ • Profile Value (TJ) = 146, which is Heavy

APPENDIX A:

Determine appropriate limits threshold	<ul style="list-style-type: none"> Determine the lower limit adjustment factor in Table 9 & "ideal" threshold from Table 5 Multiply the "ideal" threshold from Table 5 by the lower limit adjustment factor from Table 9 	<ul style="list-style-type: none"> Lower Factor = 0.2 Lower "ideal" threshold = 120 TJ $-120 \text{ TJ} \times 0.2 = -24 \text{ TJ}$
Calculate the difference	<ul style="list-style-type: none"> Calculate the difference between Market Participant Demand Forecast and AEMO Demand Forecast 	<ul style="list-style-type: none"> Diff = $944 \text{ TJ} - 986 \text{ TJ} = -42 \text{ TJ}$
Compare Thresholds	<ul style="list-style-type: none"> Compare calculated Thresholds against calculated difference between the forecasts. If the difference between these exceeds either the lower or upper threshold limits, override Market Participants Demand Forecast by an amount that will bring the Market Participants Demand Forecast in line to the outer limit of the threshold 	<ul style="list-style-type: none"> Threshold = -24 TJ Diff = -42 TJ Difference exceeds the threshold hence there is an override Override = Threshold – Diff $= -24 \text{ TJ} - (-42) \text{ TJ} = +18 \text{ TJ}$
Produce Total Demand	<ul style="list-style-type: none"> Calculate the Total Demand Forecast by adding or subtracting the Demand Override to the MP Demand Forecast 	<ul style="list-style-type: none"> Total Demand = MP Demand Forecast + Demand Override $= 944 \text{ TJ} + (18) \text{ TJ} = 962 \text{ TJ}$

Example 3

- March 10:00 PM horizon, BOD linepack = 23 TJ below target.
- AEMO Total Demand Forecast 336 TJ.
- MP Total Demand Forecast = 368 TJ
- Profile Value = 21 TJ

Process		
Determine Variables and Conditions	<ul style="list-style-type: none"> Determine the BOD linepack level in Table 7 Select the appropriate AEMO forecast demand range in Table 8. Determine the profile factor based on Table 6. 	<ul style="list-style-type: none"> -23 TJ, low BOD linepack Range < 630 TJ Profile Value (TJ) = 21, which is Average
Determine appropriate limits threshold	<ul style="list-style-type: none"> Determine the upper limit adjustment factor in Table 9 & "ideal" threshold from Table 5 Multiply the "ideal" threshold from Table 5 by the upper limit adjustment factor from Table 9 	<ul style="list-style-type: none"> Upper Factor = 1.0 Upper "ideal" threshold = 30 TJ $30 \text{ TJ} \times 1.0 = +30 \text{ TJ}$
Calculate the difference	<ul style="list-style-type: none"> Calculate the difference between Market Participant Demand Forecast and AEMO Demand Forecast 	<ul style="list-style-type: none"> Diff = $368 \text{ TJ} - 336 \text{ TJ} = 32 \text{ TJ}$
Compare Thresholds	<ul style="list-style-type: none"> Compare calculated Thresholds against calculated difference between the forecasts. If the difference between these exceeds either the lower or upper threshold limits, override Market Participants Demand Forecast by an amount that will bring the Market Participants Demand Forecast in line to the outer limit of the threshold 	<ul style="list-style-type: none"> Threshold = 30 TJ Diff = 32 TJ Difference exceeds the threshold hence there is an override Override = Threshold – Diff $= +30 \text{ TJ} - 32 \text{ TJ} = -2 \text{ TJ}$
Produce Total Demand	<ul style="list-style-type: none"> Calculate the Total Demand Forecast by adding or subtracting the Demand Override to the MP Demand Forecast 	<ul style="list-style-type: none"> Total Demand = MP Demand Forecast + Demand Override $= 368 \text{ TJ} + (-2) \text{ TJ} = 366 \text{ TJ}$

EXAMPLES