CREDIT LIMIT PROCEDURES CONSULTATION SUPPORTING INFORMATION

PREPARED BY:	Market Performance
VERSION:	1.0
DATE:	18 June 2012

FINAL

Contents

Glossary

TERM	MEANING
CLP	Credit limit procedures
MCL	Maximum credit limit
MLF	Marginal loss factor
OSL	Outstandings limit
PLGD	Probability of loss given default
POE	Probability of exceedance
PM	Prudential margin
PRAF	Participant risk adjustment factor
VF	Volatility factor

1 Introduction

In October 2011 the Australian Energy Market Operator (AEMO) submitted its New Prudential Standard and Framework in the NEM Rule change proposal to the Australian Energy Market Commission (AEMC). The AEMC published a draft determination on this Rule proposal on 12 April 2012.

Several submissions to the Rule change proposal first round of consultation requested an understanding of the Credit Limit Procedures (CLP) in order to properly assess the merits of the proposed Rule. The CLP sets out the methodology to be followed in setting each Market Participant's prudential settings (maximum credit limit (MCL), outstandings limit (OSL) and prudential margin (PM)) and ultimately their level of credit support. These prudential settings are determined in order that the prudential standard outlined in the Rule change proposal is met.

In order to meet the requirements of its stakeholders AEMO is consulting on its CLP under draft clause 3.3.8 of the AEMC's Draft National Electricity Amendment (New Prudential Standard and Framework in the NEM) Rule 2012. This consultation is being conducted in accordance with the Rules consultation requirements set out in clause 8.9 of the Rules.

2 Credit Limit Procedures Methodology

The CLP has been drafted to meet the prudential standard and take into consideration the elements outline in the draft Rule. The CLP takes the following steps:

- Set regional volatility factors (VF) and prices that will meet the prudential standard (considered to be a 2% prudential probability of exceedance) at a regional level. Factors included in this are
  - The establishment of an OSL and PM that sum to the MCL
  - A three season approach (Summer, Winter, Shoulder)
  - Utilisation of historical price and energy data for the region in determining the standard
  - The time periods of the OSL (35 days) and PM (7 days)
- Set participant specific factors that reflect the difference between a Market Participant's portfolio and that of the region average. The factors considered are
  - Load volatility
  - Generation volatility
  - Half hourly load profiles, including actual MLFs applicable at wholesale connection points
  - Half hourly generation profiles, including actual MLFs applicable at wholesale connection points
  - Half hourly reallocation profiles
- Calculate a participant's OSL, PM and MCL incorporating
  - Days in OSL and PM
  - Level of daily load
  - Level of daily generation
  - Level of daily reallocation
  - Regional factors (VF and price)
  - Participant specific factors (volatility, profiling, losses)
  - Inter-regional adjustments

- Goods and Services Tax (GST)

The following table identifies how each of the factors in the draft Rule is incorporated into the CLP methodology

Draft Rule requires AEMO to consider:	Used in:
the *regional reference price* for the *region* for which the *prudential settings* are being calculated	• Establishing that point where the probability of loss given default (PLGD) is 2% for each region • As a basis for estimating a *Market Participant's* characteristics relative to those of the *region* as a whole
the time of year	• The introduction of 3 seasons (summer, winter and shoulder) reflecting the behaviour of market prices. *Regional* characteristics (RRP for the *region*; volatility factor; expected *regional load*) are all estimated on a seasonal basis • *Market Participants'* OSLs and PMs vary with the seasons.
the volatility of *load* and *regional reference price* for the *regions*	• In the calculation of the regional volatility factor consistent with the 2% PLGD target • As a basis for estimating a *Market Participant's* characteristics relative to those of the region as a whole
AEMO*'s estimate of the *generation* and *load* for each *Market Participant	• Calculating the *Market Participant's* OSL and PM
the relationship between average *load* and peak *load* for each *Market Participant*	• Estimating a *Market Participant* specific Participant Load Weighted Price. The Participant Load Weighted Price is used in adjusting the OSL and PM to reflect the *Market Participant's* riskiness relative to that of the *region* as a whole.
any *prospective reallocations* for the period being assessed	• Establishing a *Market Participant's* OSL and PM • Assessment of half hourly profiles to adequately value *reallocations* across the day
the correlation between *energy*, *reallocations* and the *regional reference price*	• The *Market Participant* specific adjustments to *load*, *generation* and *reallocations* that reflect the relationship between the *Market Participant's* Load Weighted Price and the comparable RRP • The relevant Participant Load Weighted Price to calculate the participant's *load*, *generation* and *reallocation* amounts as the basis for the calculation of the participant's OSL and PM.

Draft Rule requires AEMO to consider:	Used in:
the statistical distribution of any accrued amounts that may be owed to *AEMO*	• The basis for the calculation of the Regional Volatility Factor consistent with the 2% PLGD objective • Determination of the Market Participant specific characteristics applied to the calculation of *load*, *generation* and *reallocations*, so as to allow for differences in the likely accruals of *Market Participants* with different characteristics
the relevant time period for which the prudential settings are being calculated	• Calculation of OSL for which the time period is 35 days • Calculation of PM for which the time period is 7 days

3 Prudential Standard

The prudential standard sets the level of credit support required in the NEM. The regional level VFs and prices in the NEM are derived to meet the 2% probability of exceedance (POE) measure. The following sections describe the POE and how VFs and prices are determined in order to meet the 2% measure.

When determining the POE and other regional parameters data from the following timeframes are considered:

	NSW	QLD	SA	TAS	VIC
Exceedance count	Jan 2000 to Dec 2011	Jan 2000 to Dec 2011	Jan 2000 to Dec 2011	Apr 2006 to Dec 2011	Jan 2000 to Dec 2011
Price and Load Data	Dec 1999 to Dec 2011	Dec 1999 to Dec 2011	Dec 1999 to Dec 2011	May 2005 to Dec 2011	Dec 1999 to Dec 2011

3.1 2% Probability of Exceedance

The new prudential standard in the draft Rule is a 2% POE:

> '**prudential probability of exceedance** means the probability of the *Market Participant's* maximum credit limit being exceeded by its *outstandings* at the end of the reaction period following the *Market Participant* exceeding its outstandings limit on any day, and failing to rectify this breach.'

This standard is assessed over the entire life of the NEM and can be considered as an event that is only allowed to happen on average seven times a year. An exceedance event occurs when there is a breach of the trading limit today <u>and</u> in the reaction period there is a run through the PM. In this case, if there is a suspension at the end of the reaction period a shortfall to the market would occur.

When considering if there is an exceedance event the assumption is made that any breach that occurred yesterday was rectified to the level of the OSL before assessing if there is an exceedance event today. (An exceedance event is synonymous with the concept of a loss given default.) This concept is illustrated below.

Figure 1a – Day x: Breach of OSL with no subsequent exceedance.

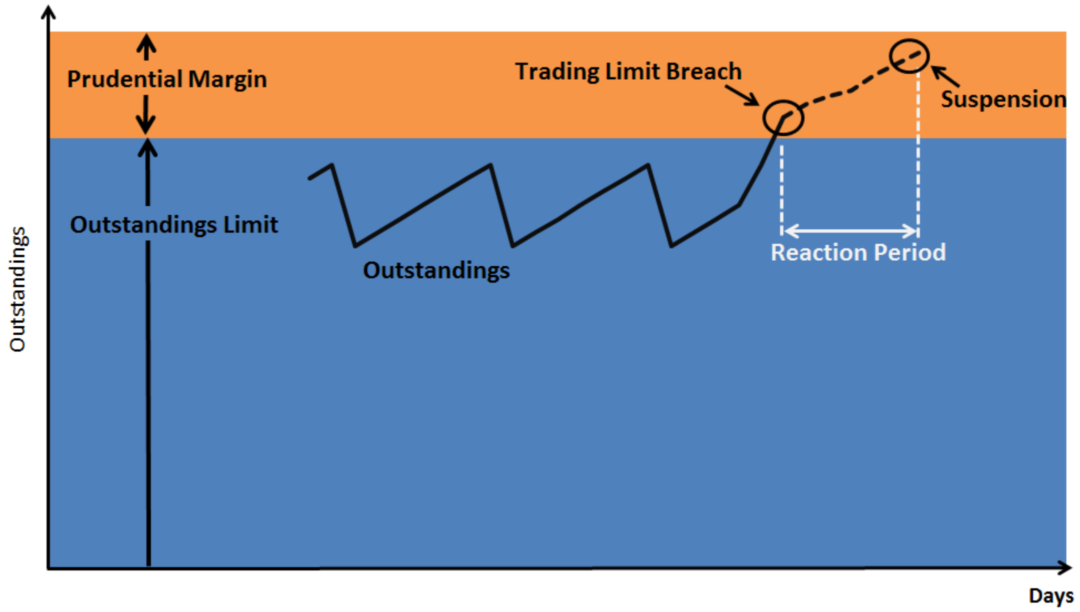
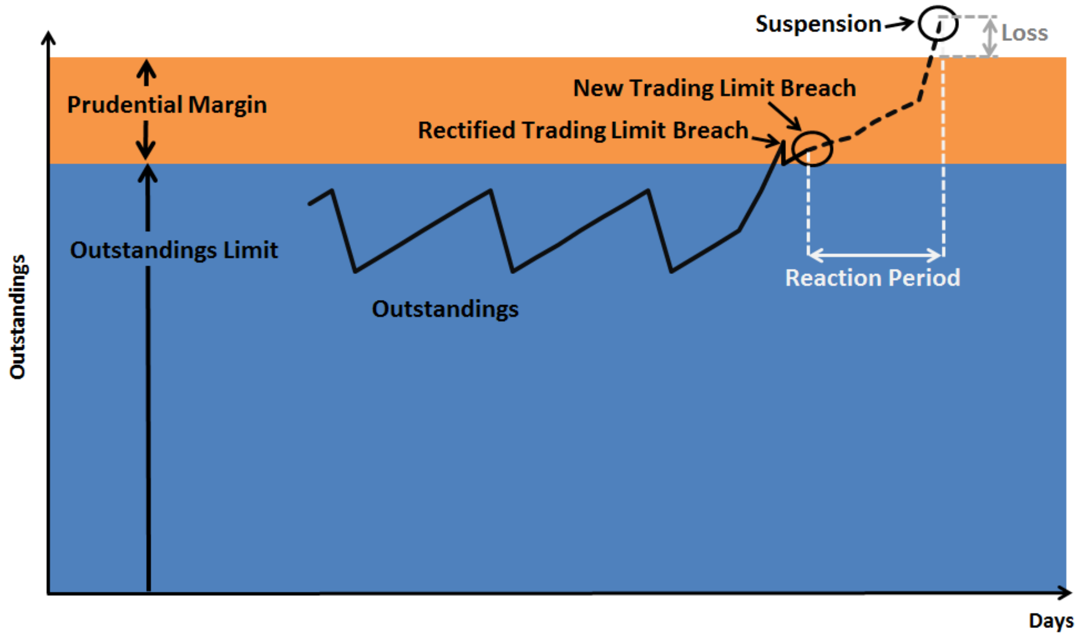


Figure 1b – Day x+1: Breach of OSL with subsequent exceedance



In this illustration it is assumed that the Market Participant has provided credit support to the level of the MCL ie the trading limit and OSL are equivalent.

In figure 1a it is day x and there is a trading limit breach, however the subsequent increase in outstandings during the reaction period does not cause the PM to be breached. This would not be an exceedance event.

In figure 1b it is day x+1 and it is assumed that the trading limit breach for day x has been rectified to the level of the outstandings limit. There is a further trading limit breach on day x+1 and the subsequent increase in outstandings during the reaction period causes the PM to be breached. This is an exceedance (or loss) event.

In meeting the prudential standard the credit support requirements are to be set such that an exceedance event, as described above, only occurs on average once in every 50 days.

3.2 Regional Factors to meet the 2% Prudential Standard

Regional factors (load and price) are determined and used in a model that is calibrated to determine the level of VFs (OSL and PM) required to meet the prudential standard. The current credit limits methodology determines the VF as the maximum (100th percentile) outcome over the past year. In the CLP methodology a level of VF that is sufficient to meet the prudential standard in the region is calculated.

The regional model is created by assuming that the region is a retailer without generation or reallocations. The region's outstandings are plotted against the OSL and PM based on regional price and regional load which are calculated as described in the following sections. The calibration of VF required for OSL and PM to meet the standard is determined by changing the OSL and PM until the model averages 1 exceedance every 50 days.

Consistent with Seed Advisory and Taylor Fry's report The Prudential Standard in the NEM published as part of AEMO's Energy Market Prudential Readiness Review[1], analysis has shown that there are three distinct timeframes during the year that exhibit similar volatility and pricing behaviour. The regional model is based on these three timeframes which have been termed seasons and named winter (May to Aug), summer (Dec to Mar) and shoulder (April, Sep to Nov).

The regional model has been performed with a seasonal approach to VFs and prices. This means that the VFs and price for any season can be determined as soon as the previous like season has concluded. This will provide advance information to the market place which the current methodology is unable to afford.

Figure 2 – Regional Outstandings against Regional OSL and PM

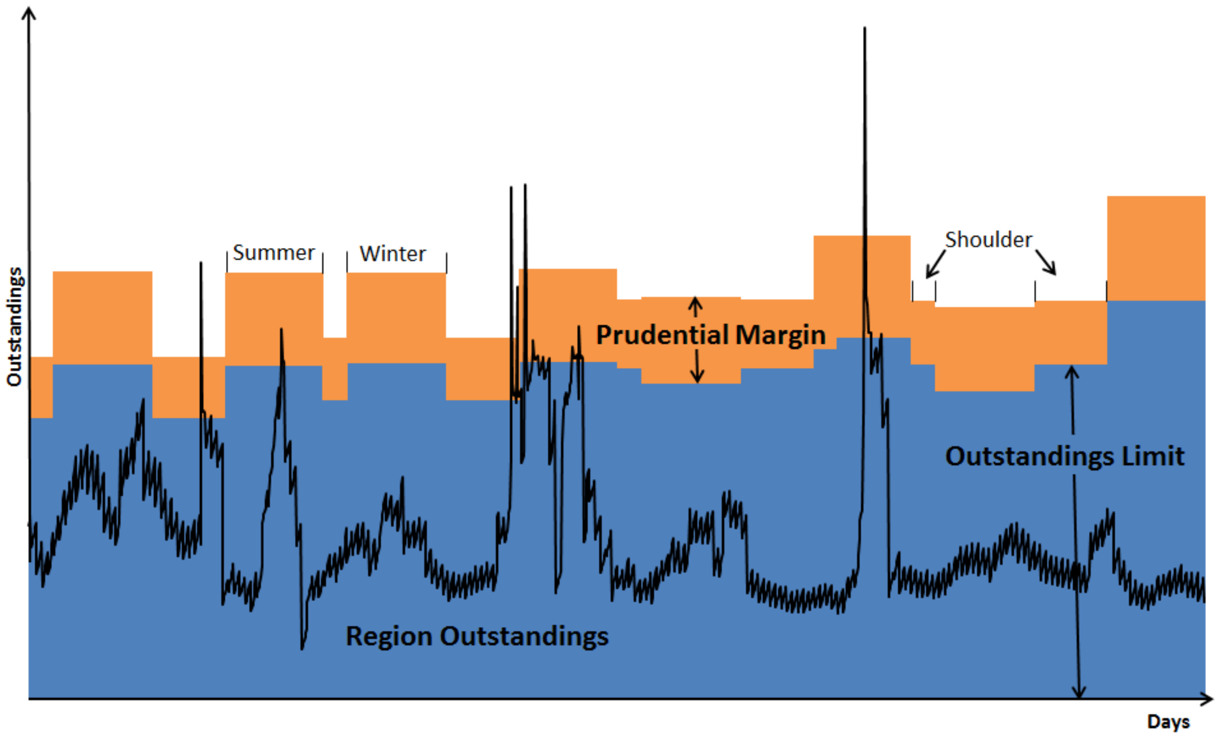


Figure 2 illustrates 4 years of regional outstandings against the OSL and PM for the region. The OSL and PM are calculated for each season of Summer, Winter and Shoulder based on the load and price determined for each season and using the standard load x price x days x VF calculation. The level of VF required to meet a 2% exceedance is determined over the timeframes described in section 3. The details of this process are described in greater detail below.

[1] http://www.aemo.com.au/en/Electricity/Settlements/Prudentials/Energy-Market-Prudential-Readiness-Review

3.2.1 Regional Load

In order to calculate an OSL and PM for each season a load for each season is required. This average daily load value is calculated by taking 30% of the forecast daily load for the previous like season and adding it to 70% of the previous like season's actual average daily load. This then becomes the forecast for the current season and is used in the calculation of the current season's OSL and PM.

Worked example:

Summer X Forecast Load (based on Summer X-1 forecast and actual daily load)

= 150,000 MWh per day (this value is used for calculating Summer X OSL and PM values)

Summer X Actual Load = 170,000 MWh per day (calculated at the end of the Summer X)

Summer X+1 Forecast Load = 30% of Summer X Forecast Load and 70% Summer X Actual Load

= 0.3 x 150,000 + 0.7 x 170,000 = 164,000 MWh per day.

This value is used in the regional model for calculating Summer X+1 OSL and PM values.

The exponential weighting has been determined through analysis to provide the best balance between stability and performance of the model.

The starting point of the load values have been determined by applying an exponential regression methodology.

3.2.2 Regional Price

In order to calculate an OSL and PM for each season a price for each season is required. This average price value is calculated by taking 90% of the forecast average price for the previous like season and adding it to 10% of the previous like season's actual average price. This then becomes the forecast for the current season and is used in the calculation of the current season's OSL and PM.

Worked example:

Summer X Forecast Price (based on Summer X-1 forecast and actual price)

= $50 per MWh (this value is used for calculating Summer X OSL and PM values)

Summer X Actual Price = $45 per MWh (calculated at the end of the Summer X)

Summer X+1 Forecast Price = 90% of Summer X Forecast Price and 10% Summer X Actual Price

= 0.9 x 50 + 0.1 x 45 = $49.50 per MWh.

This value is used in the regional model for calculating Summer X+1 OSL and PM values.

The exponential weighting has been determined through analysis to provide the best balance between stability and performance of the model.

The starting point of the price values have been determined by applying an exponential regression methodology.

A cap in the movement of price from one season to the next like season of +/-10% is also applied to ensure that prices do not over react to one off increases or decreases in a season that analysis has shown need not be reflected in subsequent seasons in order to meet the 2% prudential standard.

3.2.3 Regional OSL VF and PM VF

In order to calculate an OSL and PM for each season a VF for OSL and for PM for each season is required. The VFs are determined in order to achieve the 2% prudential standard over the history of outstandings in the region. A percentile approach to VFs allows the relative levels of OSL and PM between each season and also between each other to be maintained.

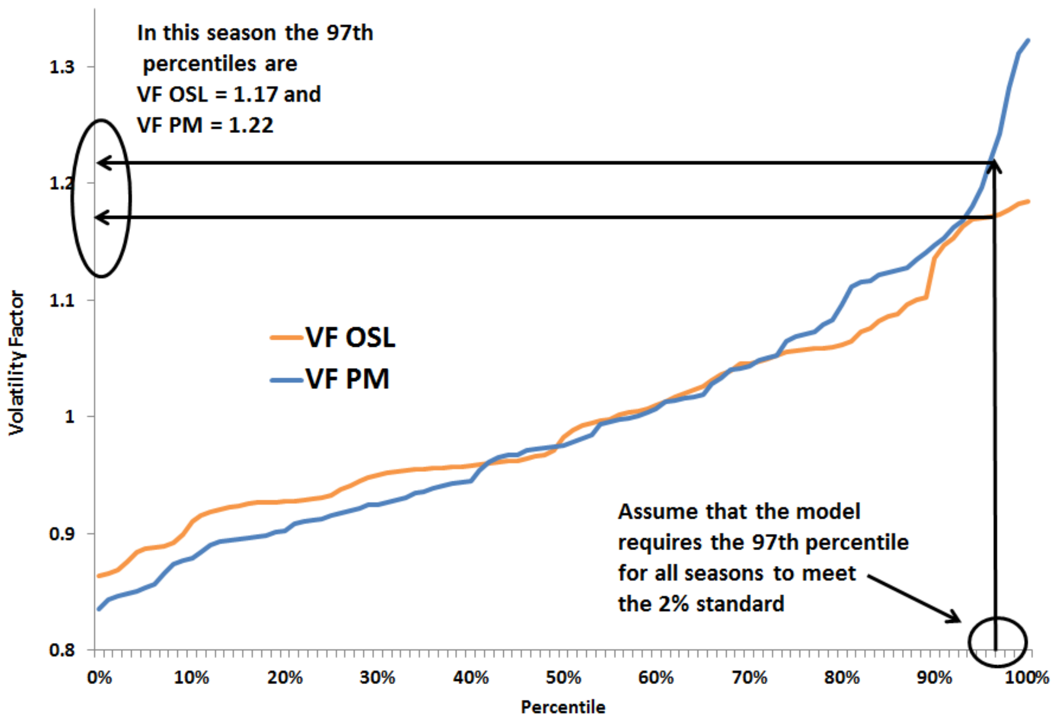
The first step in determining which percentile of VF we apply to the region is to calculate the range of VFs that occurred for OSL and PM in each season. This process is very similar to the current VF process.

Taking the OSL VF as an example, for each day in the season a 35 day average value of load is calculated using data from that day and the preceding 34 days. For any given day if there is insufficient history in the season that day occurs in then the most recent days from the previous like season are used to calculate that day's 35 day average. Each day's 35 day average value is then divided by the mean of the 35 day averages in that season. This process results in a VF for each day in the season.

The same process is performed for the PM VF calculation except that 7 day averages are used. Once each season has a list of VFs for both PM and OSL these are considered in terms of their percentiles. For example, if the model was calibrated to a VF percentile of 100 then the maximum VF value for each season for both PM and OSL would be utilised. In practise this approach would give a standard that exceeded the 2% required and so the model is calibrated by moving through the percentile outcomes of the VFs until the 2% is met. This is illustrated below.

It is important to note that as the percentile of VF utilised in the model is changing all the PMs and OSLs in the model are changing. In this way the model calibrates against the historic outstandings until the 1 day in 50 exceedance rate is met.

Figure 3 – Regional VF OSL and VF PM outcomes for Season X



As for the load and prices used in the regional model an exponential moving average approach is applied to the VFs that are used in the calculation of OSL and PM in the regional model. The VF applied in the model is based on 90% of the previously forecast VF in the like season plus 10% of the actual VF that occurred in that season. This process is applied to both PM and OSL VFs.

Worked example

The regional model has been calibrated and 97th percentile VFs are required to meet the standard.

Summer X Forecast VF OSL (based on Summer X-1 forecast and actual VF)

= 1.60 (this value is used for calculating Summer X OSL and PM values)

Summer X Actual VF OSL = 1.17 (calculated at the end of the Summer X, see figure 3)

Summer X+1 Forecast VF = 90% of Summer X Forecast VF and 10% Summer X Actual VF

= 0.9 x 1.60 + 0.1 x 1.17 = 1.56.

The starting point of the VF values have been determined by applying an exponential regression methodology.

A cap in the movement of VF from one season to the next like season of +/-10% is also applied to ensure that VFs do not over react to one off increases or decreases in volatility that analysis has shown need not be reflected in subsequent seasons in order to meet the 2% prudential standard.

3.2.4 Calibrating the Regional model

The regional model illustrated in figure 2 can be calibrated against the outstandings by calculating the OSL and PM for each season based on the processes described above. The OSL and PM values are calculated according to the formulae:

OSL = daily load x price x VF OSL x 35 days

PM = daily load x price x VF PM x 7 days.

The daily load and price amounts for each season are determined from historic data as described in sections 3.2.1 and 3.2.2 above.

The VF percentile is then changed, varying OSL and PM values for each season in the model, until the minimum VF percentile that is required to meet the 2% standard is found. This percentile is adopted in the CLP for the region. The variation of PLGD with VF percentiles is illustrated below:

Figure 3 – PLGD against VF percentile for each Region in the NEM

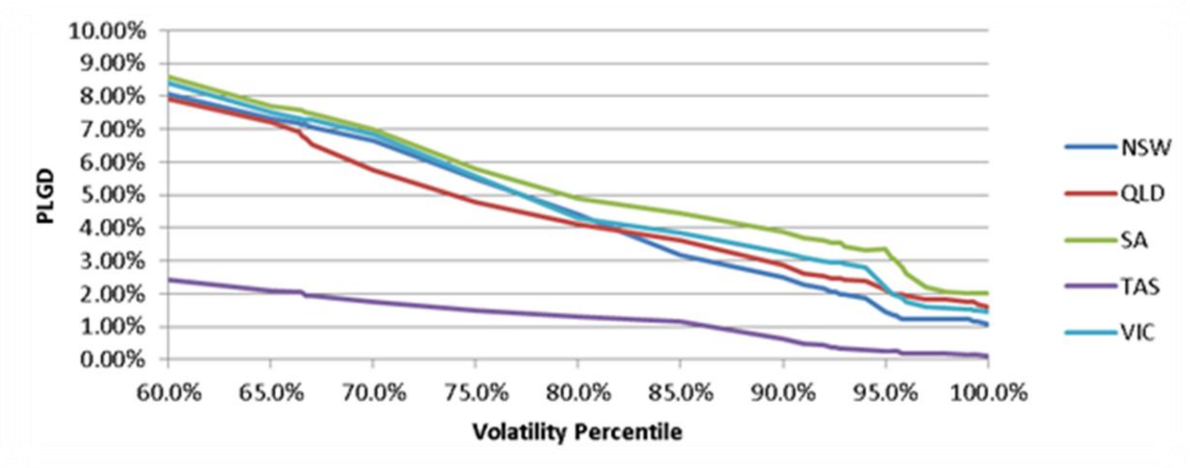


Figure 3 illustrates that with the exception of Tasmania most regions require a VF outcome from the 93rd to 98th percentile in order to meet the 2% prudential standard.

It is important to understand that once the model is calibrated it is not intended that it should be recalibrated every year. If the 97th percentile is identified as the required VF outcome for the region at the time that the CLP is implemented then that percentile will be used to calculate VFs until such time that sufficient history has occurred to meaningfully revisit the performance of the model and amend the percentile if the prudential standard is not being met. It is considered that this will be a period of at least 3 years from the start of the CLP.

The analysis performed to the end of 2011 resulted in the following percentile outcomes per state:

Region	NSW	QLD	SA	TAS	VIC
VF Percentile	93.0%	95.4%	99.5%	66.6%	95.3%

4 Calculating a Market Participant's MCL

The Market Participant MCL will be calculated as OSL plus PM and these values will be determined both from the regional specific inputs (price and VFs) and from Market Participant specific parameters. The Market Participant specific parameters are intended to reflect how the Market Participant differs from the regional model and take this differentiation into account such that each Market Participant's prudential position can meet the 2% prudential standard.

4.1 Common Region Based Parameters

The basic equation for calculating the OSL and PM is similar to that currently used to calculate the MCL. At its core are the equations

OSL = daily load x price x VF OSL x 35 days and

PM = daily load x price x VF PM x 7 days

where VFs and price are regional parameters

The method for calculating price for the next season is that used in the regional calibration model and described in the worked example in 3.2.2 above.

Calculating the price requires knowledge of the price used in the previous like season's MCL calculation and the actual average price from the previous like season.

The method used for calculating VFs for the next season is that used in the regional calibration model and described in the worked example in 3.2.3 above. The VF is based on the percentile outcome for the region to be determined and published by AEMO.

Calculating the VFs requires knowledge of the VFs used in the previous like season's MCL calculation and the actual percentile outcome of VFs from the previous like season.

4.2 Market Participant Specific Parameters

The Market Participant specific parameters of daily load, generation and reallocations will be determined in the same way as is currently performed. The load and generation will be assessed by reference to recent participant load and generation patterns. Reallocations will be based on assessment of authorised ex ante reallocations.

A series of new and amended parameters, participant risk adjustment factors (PRAFs), have been introduced that are intended to differentiate participants based on load profiles, load factor and loss factor considerations in accordance with the requirements of the AEMC's draft Rule.

The PRAFs will be determined by assessing the Market Participant's recent history of marginal loss factor (MLF) adjusted energy and reallocation patterns in the region against the region load profiles.

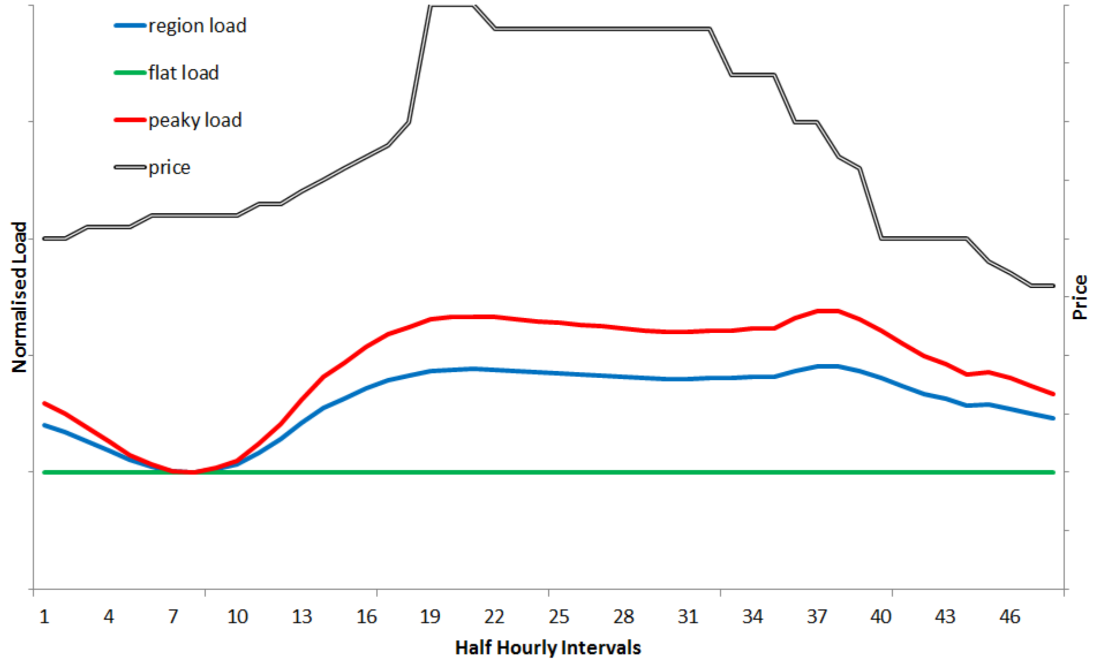
4.2.1 Load Profile Factors

The VFs and average price determined for a region are a function of the average distribution of price and load. Where a participant has a load, generation or reallocation distribution that does not match the regional profile there is scope for that load, generation or reallocation to be over or under valued in the OSL and PM calculations.

In order to accurately reflect a participant's relative load profile an adjustment is to be made that equates to the ratio of the participant's load weighted price (adjusted for MLFs) to the region's load weighted price. A participant that tends to have a greater proportion of load during the high price times of the day than the regional average will have a load profile adjustment greater than 1. A participant that has a flat load such that they have a lower proportion of load during the high price times of the day than the region will have a load profile adjustment less than 1.

This concept is illustrated below:

Figure 5: Illustrative load and price profiles



In the figure above the flat load will result in a load weighted average price that is equivalent to the average price for the day. However, the region load tends to be higher when the prices are high and will have a load weighted price higher than the average price. The peaky load is relatively higher during the higher prices than the region load and will have a higher load weighted price again.

The load weighted price is the sum of each half hourly load times half hourly price during the day divided by the daily load. In determining the regional load weighted price half hourly profiles of both load and price are determined in a manner similar to that described for the daily load and price in sections 3.2.1 and 3.2.2. In this case, a forecast will be determined for each half hour rather than each day.

In determining the Market Participant's load weighted price an assessment of recent load patterns of the Market Participant will be undertaken. The half hourly load profile (with and without MLF adjustments) of the Market Participant will then be used in conjunction with the half hourly price profile that has been calculated for the region to determine a load weighted (and MLF adjusted) price. A load weighted price ratio of the Market Participant's load weighted price divided by the region's load weighted price is used to reflect the participant's risk relative to the region average.

The profiling issue also impacts generation and credit and debit reallocations and consequently factors are derived to reflect these also. Like load and credit reallocations the value of generation and debit reallocations will be increased if they exhibit higher load weighted average prices than the region.

4.2.2 Load Volatility Factors

As well as a half hourly load profile that is inconsistent with the region a Market Participant can have a daily load that increases proportionately more than the region load when this is increasing. Analysis has revealed that the ratio of the Market Participant's load weighted price to the region's load weighted price is a reflection of this characteristic and it should be applied to reflect this risk if the Market Participants load weighted ratio is greater than 1.

The benefit of a load weighted price ratio lower than one is sufficiently recognised in the adjustment to price and is not appropriate as an adjustment to VF also.

4.2.3 Marginal Loss Factors

The price x load calculations to derive an MCL are subject to marginal loss factors (MLFs). The current MCL methodology approximates these losses to a 5% increase in the value of all load and generation. Analysis has shown that this approximation is not appropriate. In particular MLFs should result in a reduction in value for most generation and some loads are subject to significantly higher and lower MLFs than 5%.

The MLFs are now included in the calculation of a Market Participant's load weighted price calculation, as described in section 4.2.2, and as such MLFs will be included in the Market Participant's PRAF.

5 Credit Offsets in the Prudential Margin.

The notice of first stage of consultation for the draft CLP includes AEMO's intention to seek a redrafting of the PM definition from that defined in the draft Rule. AEMO's submission will review the netting of generation or credit reallocations in determining the PM.

6 Miscellaneous

The CLP adopts an approach to calculating the OSL and PM that is often consistent with the current credit limits methodology. The following sections outline significant differences not covered in sections 3 to 4 that benefit from some explanation.

6.1 Immediate Review Provision

It is not envisaged under the CLP and 2% prudential standard that market wide MCL reviews will occur when there are large, short term increases in volatility and price. However, the right to review each Market Participant's MCL at any time based on changes to load, generation and reallocations has been maintained.

6.2 Inter Regional Adjustments

The CLP addresses inter regional adjustments in much the same way as the current methodology in that it only values net credit that is set against a net debit in another region at a VF of 1. The formulation has changed considerably and two worked examples are provided below.

Worked example 1: Participant is active in two regions A and B has an overall debit position.

	Region A Net Credit:	Region B Net Debit:	Total
VEL		$240	
VEG	$100		
VFOSL	2	3	
$OSL_{R,U}$	-$100 x 35 = -$3,500	$240 x 35 = $8,400	
$OSL_{R,I}$	-$100/2 x 35 = -$1,750	$240/3 x 35 = $2,800	
OSL	-$1,750	$8,400	$6,650

Worked example 2: Participant is active in three regions A, B and C and has an overall credit position.

	Region A Net Credit:	Region B Net Debit:	Region C Net Credit:	Total
VEL_R		$240		
VEG_R	$100		$1,000	
$VFOSL_R$	2	3	2.5	
$OSL_{R,U}$	-$100 x 35 = -$3,500	$240 x 35 = $8,400	-$1,000 x 35 = -$35,000	
$OSL_{R,I}$	-$100/2 x 35 = -$1,750	$240/3 x 35 = $2,800	-$1,000/2.5 x 35 = -$14,000	
OSL	-$1,750	$8,400	-$14,000	-$7,350

6.3 OSL, PM and MCL

In determining the MCL as MCL = OSL + PM the following conditions have been applied:

- The MCL cannot be less than zero.
- The PM cannot be less than zero.

7 Data and MCL Calculators

In order to facilitate Market Participant's analysis of the draft CLP three MCL calculators have been published on the consultation page. A calculator for each season is provided as the regional load profiles required to assess a Market Participant's PRAFs are different for summer, winter and shoulder. The calculators have the required VF, price and profile data for summer 2011-12 (December to March), winter 2011 (May to August) and shoulder 2011 (April, September to November).

The MCL calculators are intended to allow Market Participants to input their own energy and reallocations data and profiles and analyse the impact on their MCL requirement. The calculator workbooks are to be used as follows:

- Worksheets 'NSW', 'QLD', 'SA', 'TAS' and 'VIC' are to be filled in with:
  - Market Participant's daily load, generation and reallocation information for that region.
  - Market Participant's load and generation half hourly profiles (with and without MLF adjustments) and reallocation half hourly profiles for that region. This data is used in the determination of PRAFs.
- The 'Region' worksheet has:
  - The P_R, $VFOSL_R$ and $VFPM_R$ data used in the calculation of the MCL is provided. This data (in shaded area) can be manipulated to understand the impact of variances in these parameters.
  - The regional half hourly load, price and capped price (for cap of $100) data is provided. This data is used in the determination of PRAFs.

- The 'MCL' worksheet has:
    - High level parameters calculated in the determination of the OSL, PM and MCL. These include VEL_R, VEG_R, VRC_R, VRD_R, $OSL_{R,U}$, and $OSL_{R,I}$
    - The calculated OSL, PM and MCL

In addition a Credit Limits Procedure Data document has been provided which contains:

- Pricing (P_R) and VF ($VFPM_{R,}$ $VFOSL_R$) data under the CLP model.
- Actual price (AP_R) and actual VF ($VFPM_{R,}$ $VFOSL_R$) data under the CLP model.
- Pricing and VF data under the current credit limits methodology for comparison.
- Regional load (ERL_R, $AERL_R$) data used in the regional model to determine VF percentiles.

The data and calculators provided are for the purpose of assessment and analysis of the CLP only and do not represent the finalised values that will be published upon implementation of the finalised CLP. Implementation of the finalised CLP (currently targeted for mid 2013) will incorporate as much recent price and load history in the regions as is practical at the point of implementation.

7.1 Impact of the Carbon Price on the CLP

The current analysis for the CLP only incorporates currently available data and does not consider the implications of the introduction of a Carbon Price in July 2012. AEMO is intending to undertake an assessment of the impact of the carbon price on the CLP calculations for inclusion within the draft determination of the CLP.