

**Balancing and Settlement Code**

**Code Subsidiary Document**

**Loss of Load Probability Calculation Statement**

**Version 1.0**

**Effective Date: 5 November 2015**

**LOSS OF LOAD PROBABILITY CALCULATION STATEMENT****relating to****THE METHODS USED TO CALCULATE LOSS OF LOAD PROBABILITY VALUES**

1. This statement refers to the Balancing and Settlement Code dated 5 November 2015 and, in particular, to the requirements for a Loss of Load Probability Calculation Statement in Section T 1.6A thereof.
2. This Statement, Version 1.0, is effective from 5 November 2015.
3. The Authority has approved this Statement.

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**AMENDMENT RECORD**

<b>Version</b>	<b>Date</b>	<b>Description of Changes</b>	<b>Changes Included</b>	<b>Mods/ Panel/ Committee Refs</b>
1.0	05/11/15	Approved version	P305	P244/11

## 1. Introduction

The Balancing and Settlement Code uses Loss of Load Probability (LoLP) values in the calculation of Reserve Scarcity Prices. This Loss of Load Probability Calculation Statement (the Statement) explains how the Transmission Company calculates Loss of Load Probability values.

### 1.1 Scope and Purpose of the Statement

In accordance with BSC Section T 1.6A, the BSC Panel (the Panel) is required to establish and maintain a Loss of Load Probability Calculation Statement.

This Statement sets the method for calculating LoLP values pursuant to the Static LoLP Function Method ('the Static Method') and the Dynamic LoLP Function Method ('the Dynamic Method') and the method for calculating a Static LoLP Function.

This Statement includes:

- (a) the constant parameters to be used in the determination of LoLP;
- (b) where applicable, the range of values used to determine LoLP values and functions; and
- (c) the processes to follow for reviewing, updating and publishing parameters that are to be performed by the Transmission Company on a regular basis.

### 1.2 Balancing and Settlement Code Provision

Interested parties should read this Statement in conjunction with the BSC and in particular Sections Q and T. The Panel established this Statement in accordance with the provisions of BSC Section T 1.6A. In the event of an inconsistency between the provisions of this Statement and the BSC, the provisions of the BSC shall prevail.

### 1.3 Main Users of the Procedure and their Responsibilities

The main users of this Statement are:

- The Transmission Company
- Generators
- Suppliers
- Non-physical traders

### 1.4 Use of the Procedure

The remaining sections in this document are:

Section 2 – 'Context'

Section 3 – 'Common calculation building blocks'

Section 4 – ‘Static Loss of Load Probability’

Section 5 – ‘De-rated margin’

Section 6 – ‘Dynamic Loss of Load Probability’

## 1.5 Review Procedure for the LoLP Calculation Statement

The Panel may review this Statement from time to time and make changes, subject to the Authority’s approval in accordance with BSC Section T 1.6A.3, 1.6A.4 and 1.6A.5.

The Panel will determine how it intends to review the Statement. Any review of the Statement must include consultation of Parties and other interested parties. The Panel must consider any representations made during the consultation and provide copies of any written representations to the Authority.

Where the Authority approves a revised LoLP Calculation Statement:

- (a) such revised Statement shall be effective from such date as the Panel shall determine with the approval of the Authority (and shall apply in respect of Settlement Days from that date); and
- (b) the Panel Secretary shall give notice of such date to the Transmission Company and each Party.

## 1.6 Associated Code Subsidiary Documents

BSCP01 ‘Overview of Trading Arrangements’

‘Imbalance Pricing’ Guidance Note

‘Balancing Mechanism Reporting Agent’ User Requirements Specification

‘Settlement Administration Agent’ User Requirements Specification

## 1.7 Abbreviations, Acronyms and Definitions

The following is a list of abbreviations and acronyms used in this LoLP Calculation Statement:

**Table 1 - List of abbreviations and acronyms**

AV	Availability Factors
BM	Balancing Mechanism
BMRA	Balancing Mechanism Reporting Agent
BMRS	Balancing Mechanism Reporting Service
CCGT	Combined Cycle Gas Turbine
CR	Capacity Requirement

DRM	De-rated Margin
DSBR	Demand Side Balancing Reserve
FT	Per fuel type
GCAP	Conventional Generation Capacity
i	Per BMU
j	Per Settlement Period
LLR	Largest Loss Reserve
LoLP	Loss of Load Probability
LT	Lead Time
MW	Megawatt
OCGT	Open Cycle Gas Turbine
RRF	Response Remaining Factor
RSP	Reserve Scarcity Price
RT	Real Time
SAA	Settlement Administration Agent
SBR	Supplemental Balancing Reserve
STOR	Short Term Operating Reserve
STX	Station Load
URRM	Upward Response Reserve Multiplier
VoLL	Value of Lost Load

**Table 2 - List of subscripts and superscripts**

FT	Per fuel type
i	Per BMU
j	Per Settlement Period
RT	Real Time

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“Capacity Requirement”	The capacity (in MW) that consumers and other demand-side participants are expected to export from the Transmission System in a given Settlement Period.
“Conventional Generation Capacity”	The capacity (in MW) that conventional generators connected to the Transmission System are expected to deliver to the system in a given Settlement Period. Conventional generators are those that are connected to the Transmission System and that rely on non-renewable energy sources.
“Operational Day”	The period from 0500 hours on one day to 0500 on the following day
”Reserve Scarcity Price” (RSP)	In respect of a Settlement Period, the price determined in accordance with Section T3.13. The RSP is the product of the LoLP and VoLL It is a price that reflects the value of reserve when it is used based on the prevailing scarcity on the system
“Value of Lost Load” (VoLL)	Has the meaning given to it in Section T1.12.1. It is an administrative value that represents the price at which a consumer is theoretically indifferent between paying for their energy, and being disconnected..
“Transmission System”	means the system consisting (wholly or mainly) of high voltage electric lines owned or operated by transmission licensees within Great Britain, in the territorial sea adjacent to Great Britain and in any Renewable Energy Zone and used for the transmission of electricity
“Total Wind Generation Forecast”	Forecast of total output (in MW) expected from all wind generators connected to the Transmission System in a given hour, taking account of probability error
“BMRS Wind Generation Forecast”	Forecast of total output expected from all wind generators connected to the Transmission System in a given hour, as reported on the BMRS

Full definitions of the above acronyms are, where appropriate, included in the BSC or, where used, in this Statement.



## 2. Context

Approved BSC Modification P305 will re-price STOR Actions where the action's original utilisation price is less than the Reserve Scarcity Price (RSP) calculated for the corresponding Settlement Period. Reserve Scarcity Prices are the product of the Value of Lost Load (VoLL) and Final LoLP value.

P305 specified the use of two methods for calculating LoLP values – a Static LoLP Function Method and Dynamic LoLP Function Method. The Transmission Company will use these methods at different times such that:

From 5 November 2015 the Transmission Company will calculate Final LoLP values using the Static Method.

From 1 May 2018 the Transmission Company will calculate Indicative LoLP values using the Dynamic Method, whilst it continues to calculate Final LoLP values using the Static Method.

From 1 November 2018 the Transmission Company will calculate Indicative and Final LoLP values using the Dynamic Method.

This Statement describes the two methods for calculating LoLP values.

### 2.1 Definition of LoLP and Indicative LoLP

A LoLP value is a measure of scarcity in available surplus generation capacity that the Transmission Company will calculate for each Settlement Period. That is, for a given level of Capacity Requirement (CR) (measured in MW) on the Transmission System the associated LoLP indicates the probability that there will be insufficient Total Generation Capacity (Z) (measured in MW) to meet the CR.

There are two types of LoLP values - indicative and final. For a given Settlement Period, the Transmission Company produces Indicative LoLP values from data<sup>1</sup> it has available to it at defined lead times (at midday the day before and 8, 4 and 2 hours) ahead of Gate Closure for the Settlement Period. BSC Parties use Indicative LoLP values as an indication of the level of scarcity anticipated ahead of Gate Closure for a Settlement Period.

For the same Settlement Period, the Transmission Company produces Final LoLP values from data available to it at Gate Closure. The Final LoLP is the best indication of expected scarcity during the Settlement Period.

The Balancing Mechanism Reporting Agent (BMRA) and Settlement Administration Agent (SAA) use Final LoLP values to produce Reserve Scarcity Prices.

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<sup>1</sup> The Transmission Company uses a variety of data sources to calculate LoLP values. The data used covers the operational features and expected operation of generating plant and the expected behaviour of consumers. These data items are referred to in the remainder of this Statement.

### 3. Common calculation building blocks

The calculation of Indicative and Final LoLP values using the static and dynamic methods rely on certain common elements – i.e. Conventional Generation Capacity (GCAP), Availability Factors (AV) for different generation fuel types, and Capacity Requirement (CR)).

This Section describes these common ‘building blocks’ in more detail.

#### 3.1 Inputs

The Transmission Company uses the following data in the calculation of LoLP values, which it takes from the BM system<sup>2</sup>.

**Table 3 - Common inputs**

<b>Abbreviation/ Acronym/Term</b>	<b>Definition</b>	<b>Units/Range</b>
BMU	Balancing Mechanism Unit	
FT	Fuel type – used by the BMU	Per BMU
PN	Physical Notification - the generation capacity expected to be exported by the BMU to the Transmission System during a Settlement Period	Per Settlement Period per BMU in MW
MEL	Maximum Export Limit – the maximum level at which the BM Unit may export to the Transmission System	Per Settlement Period per BMU in MW
MZT	Minimum Zero Time - is the minimum time that a BM Unit which has been exporting must operate at zero or be importing, before returning to exporting	Per Settlement Period per BMU in minutes
NDZ	Notice to Deviate from Zero – is the time required for a BM Unit to start importing or exporting energy, from a zero Physical Notification	Per Settlement Period per BMU in minutes
NDF + STX	National Demand Forecast + station load, also referred to as ‘Demand’	Per Settlement Period in MW
Demand + Interconnector Export	Transmission system demand forecast is made up of NDF+STX and the interconnector flow where exports are positive	Per Settlement Period in MW
NBM STOR	STOR provided by non BM units	Per Settlement Period in MW

<sup>2</sup> Except NBM STOR and  $W_{fcst\_mape}$  which the Transmission Company publishes on the BMRS. The volume of NBM STOR available is in the range 0 -1500MW and  $W_{fcst\_mape}$  has a value of 0.029667503.

Abbreviation/ Acronym/Term	Definition	Units/Range
W	Total Wind Generation Forecast for GB Transmission System	Per Settlement Period in MW
$W_{fcst}$	BMU Wind Generation Forecast	Per Settlement Period, Per BMU in MW
$W_{Capacity}$	Total wind capacity available in Settlement Period	Per Settlement Period in MW
$W_{fcst\_mape}$	Mean absolute percentage error of historical $W_{fcst}$ values	Static input value calculated from historical data

### 3.2 Modelling Conventional Generation Capacity (GCAP)

In order to calculate the Conventional Generation Forecast (X), Conventional Generation Capacity (GCAP<sub>i</sub>) (i.e. excluding wind and other forms of renewable generation) is defined per BMU as follows:

$$GCAP_i = \begin{cases} MEL_i & FPN_i \neq 0 \\ MEL_i & NDZ_i < LT + 30 \text{ minutes AND unit desynchronised before } MZT_i \\ 0 & \text{otherwise} \end{cases}$$

Where:

MEL, FPN, NDZ and MZT are the averages across the Settlement Period from the latest submission per BMU

LT: Lead Time (minutes)

For a given Settlement Period, each BMU's GCAP is used in combination with a corresponding Availability Factor (see below) to calculate a Conventional Generation Forecast (X):

$$X_j = \sum(GCAP_{ij} \times AV_{ij})$$

#### 3.2.1 Treatment of NDZ (i.e. Lead Time (LT) + 30 minutes)

When deriving the available capacity of a unit, the MEL is counted for all units that can be synchronised at any point within the relevant Settlement Period (hence the NDZ accounts for the lead time at the start of the period plus 30 minutes to the end).

#### 3.2.2 Constraints

All MELs count towards GCAP<sub>i</sub> and therefore the Transmission Company calculates LoLP regardless of whether generation is behind a constraint boundary and cannot be accessed by

the Transmission Company. This is consistent with the method used by the Transmission Company in the Capacity Mechanism.

### 3.2.3 Short Term Operating Reserve (STOR)

Whilst BM STOR is included in the calculation of GCAP, the Transmission Company subtracts NBM STOR from the CR. This is because NBM STOR can consist of both generation output and demand reduction. Also, the Transmission Company measures NBM STOR differently to BM STOR (i.e. NBM STOR units do not have MELs or NDZs). Ultimately NBM STOR will reduce overall demand and so the Transmission Company subtracts it in the calculation of CR – see below.

### 3.2.4 Supplemental Balancing Reserve (SBR)

The calculation of GCAP excludes the MELs for any relevant Supplemental Balancing Reserve (SBR).

## 3.3 Modelling Availability Factors (AV)

When calculating a Conventional Generation Forecast, the Transmission Company sets common generation Availability Factors ( $AV_{FT}$ ) for different fuel types, so each BMU will have a corresponding  $AV_i$  depending on the BM Units main fuel source.

To calculate these common  $AV_{FT}$  factors, the Transmission Company sums the minimum of MEL at Real Time and the forecast MEL at one hour ahead for each BMU that uses a particular fuel type. The Transmission Company then divides the sum of minimum and forecast MELs by the total of the one hour ahead forecast MELs. This is to ensure that availability figures can never be greater than 1, as nuclear generators can ramp their MEL submissions to signal their availability. This has been calculated per fuel type and averaged across the whole year.

This availability average is calculated as follows:

$$AV_{FT} = \frac{\sum (\min(MEL_{RT\_ft}, MEL_{x\_ft}))}{\sum MEL_{x\_ft}}$$

Where:

$x$  = 1 hour ahead of real time forecasted MEL submission

For a given Settlement Period, each BMU's GCAP is used in combination with a corresponding Availability Factor (see below) to calculate a Conventional Generation Forecast (X):

$$X_j = \sum (GCAP_{ij} \times AV_{ij})$$

The Transmission Company will use the Availability Factors set out in Table 4 from 5 November 2015<sup>3</sup> are:

**Table 4 - Fuel Type Availability Factors**

Fuel type	Availability factors from forecast MEL
OIL	0.998
OCGT	0.997
NUCLEAR	0.998
HYDRO	0.988
PUMPED STORAGE	0.998
CCGT	0.989
COAL	0.986

The Availability Factors in Table 4 were calculated using data from January to December 2013. The Transmission Company used data from 2013 to set this first set of Availability Factors as this data was used in the development of LoLP methods as part of Approved Modification P305's overall development.

The Transmission Company will revise the factors each year with updated historical data at the same time as generating a new Static LoLP Function and lookup table (see Section 4.4). BSCCo will publish these revised factors alongside the lookup table on the ELEXON Portal.

In the instance of a new fuel type, there would be less than a year's worth of data required to calculate the availability of that fuel type. Therefore in these circumstances the Transmission Company will determine an appropriate interim factor and notify BSCCo of its method. If this cannot happen then the Transmission Company will take a weighted average of the availability factors to apply to the new fuel type.

### 3.4 Modelling Capacity Requirement (CR)

The Capacity Requirement (CR) for a given Settlement Period consists of system demand (Demand + Interconnector Export) plus the largest loss reserve (LLR) minus the volume of NBM STOR. This is calculated using:

$$CR = \text{Demand} + \text{Interconnector Export} + \text{LLR} - \text{NBM STOR}$$

Where:

$$\text{Demand} = \text{NDF} + \text{Station Load}$$

<sup>3</sup> Until they are reviewed – as described in section 3.3.

Where:

NDF: this the National Grid National Demand Forecast (which includes system losses)

Station Load: the internal load of power stations required to supply the needs of their equipment.

Interconnector Export: this is the flow on the interconnector where exports are positive. Calculated by:

$$\text{Interconnector Export} = \sum_{k \in IC_s} (IC\_FLOW_k)$$

$$IC_s = \{IFA, BRITNED, MOYLE, EAST\_WEST\}$$

*IC\_FLOW* = the sum of the interconnector flow with exports positive and aggregated per Settlement Period.

LLR: Largest Loss Reserve; this is the equation to determine the reserve the Transmission Company is required to hold to withstand the potential largest loss on the system (typically this largest loss is 1260MW for Sizewell B).

$$\text{LLR} = ((\text{Loss} - (\text{NDF} + \text{STX}) * 1\%) / \text{Response Remaining Factor}) / \text{Upward Response Reserve multiplier}$$

Where:

Response Remaining Factor: 0.68 [this is the amount of response remaining as some has been used already due to deviation in frequency from 50.0Hz and 49.9Hz]

Upward Response Reserve Multiplier (URRM): 0.55 [this models how much frequency response can be delivered from the available headroom]

Loss: 1260 MW is the value currently used as it is the typical largest loss that NG are holding response for.

NBM STOR: is the short term operating reserve available to the control room. As mentioned above in Section 3.2.3, the Transmission Company measures NBM STOR differently to BM STOR and because ultimately NBM STOR will reduce overall demand, the Transmission Company subtracts it in the calculation of CR – see above.

The calculation of CR does not take account of Demand Side Balancing Reserve (DSBR).

### 3.5 Modelling Wind (W)

In addition to determining a Conventional Generation Forecast (X), as described above, the Transmission Company produces a Total Wind Generation Forecast (W) (measured in MW).

The Total Wind Generation Forecast is a forecast of all expected wind generation each hour. The Transmission Company bases its Total Wind Generation Forecast (W) on the sum of individual BMU Wind Generation Forecasts ( $W_{fcst}$ ) and a related forecast error ( $W_{fcst \text{ error term}}$ ).

The Transmission Company calculates the Total Wind Generation Forecast (W) by first determining individual BMU Wind Generation Forecasts ( $W_{fcst}$ ) using its own wind forecast system. The Transmission Company's wind forecast system depends on the receipt of weather data and metered volumes from generation sites. The system processes the weather data every 6 hours to produce 48 hourly forecasts. The system blends the weather based forecasts with actual metered data to improve the accuracy of the forecasts. These individual BMU forecasts are summed together to produce a GB forecast.

The error distribution of Wind Generation Forecasts ( $W_{fcst \text{ error term}}$ ) more closely resembles a Laplace distribution than a normal distribution. Therefore the Transmission Company determines the final Total Wind Generation Forecast (W) using a Laplace distribution with the location parameter equal to the median of relevant BMU Wind Generation Forecasts ( $W_{fcst}$ ) and a scale parameter equal to the mean absolute percentage error of the sum of historical  $W_{fcst}$  values:

$$W_j \sim L(\text{location} = \text{median of } W_{fcst_{ij}} \text{ values, scale factor} = W_{fcst \text{ error term}})$$

Where:

$W_j$ : is the Total Wind Generation forecast for a given Settlement Period (j)

$$W_{fcst \text{ error term}} = W_{fcst\_mape} \times W_{capacity}$$

Where:

$W_{fcst\_mape}$  = is the mean absolute percentage error of the sum of all BMU Wind Generation Forecasts

$W_{capacity}$  = total national wind generation capacity

Whilst each Total Wind Generation Forecast covers an hour period, the same forecast is used for each Settlement Period that makes up that hour period.

The binomial distributions of X and Laplace distribution W can then be combined statistically, such that  $Z = X + W$ .

### 3.6 Common lead times for publishing values

For each Settlement Period, the Transmission Company may be required to produce Indicative LoLP, Final LoLP and forecast De-rated Margin values at specific lead times ahead of the commencement of that Settlement Period.

These specific lead times are:

- (a) at 1200 hours on each calendar day the Transmission Company shall send values applicable to all Settlement Periods for which Gate Closure has not yet passed occurring within the current Operational Day and the following Operational Day;
- (b) at 8 hours, 4 hours and 2 hours prior to the beginning of a Settlement Period the Transmission Company shall send values applicable to that Settlement Period; and
- (c) at 1 hour prior to the beginning of a Settlement Period the Transmission Company shall send a value applicable to that Settlement Period.



## **4. Static Loss of Load Probability Function Method**

### **4.1 Overview**

The Static LoLP Function Method (the ‘Static method’) of calculating LoLP values uses a pre-determined mathematical function (and lookup table) to convert a value of de-rated margin into a LoLP value. The Transmission Company derives a mathematical function from the historical relationship between these two variables.

### **4.2 Method for calculating static LoLP values from de-rated margin**

The Static method calculates Final LoLP values by using a forecast of de-rated margin (see Section 5), which the Transmission Company converts to LoLP using a pre-determined Static LoLP Function and lookup table.

### **4.3 Frequency of calculating and publishing Final LoLP values**

For each Settlement Period until 31 October 2018, the Transmission Company will calculate and send to the BMRA a Final LoLP value in accordance with the Static Method at the specific lead time set out in 3.6(c) above – i.e. at Gate Closure.

If a Gate Closure forecast of de-rated margin is not available, the Transmission Company will use the most recent forecast of de-rated margin instead. For example, the 2 hour ahead forecast or if that is not available the 4 hour ahead forecast, etc.

If no forecast of De-rated Margin is available, the Transmission Company will report the Final LoLP value to the BMRA as ‘null’.

### **4.4 Creation of Static LoLP function and lookup table**

The Transmission Company generates a Static LoLP function by determining a relationship between historical values of LoLP and de-rated margin. This relationship is represented by using a normal cumulative density function to fit a smooth curve to the historical data. As a result this curve contains all the assumptions of the dynamic model (such as wind and demand forecast accuracy). At publication of this Statement, the Static function is defined as:

$$\text{LoLP} = 1 - \text{Normal cumulative density function} (\text{DRM}_j, \mu, \sigma^2)$$

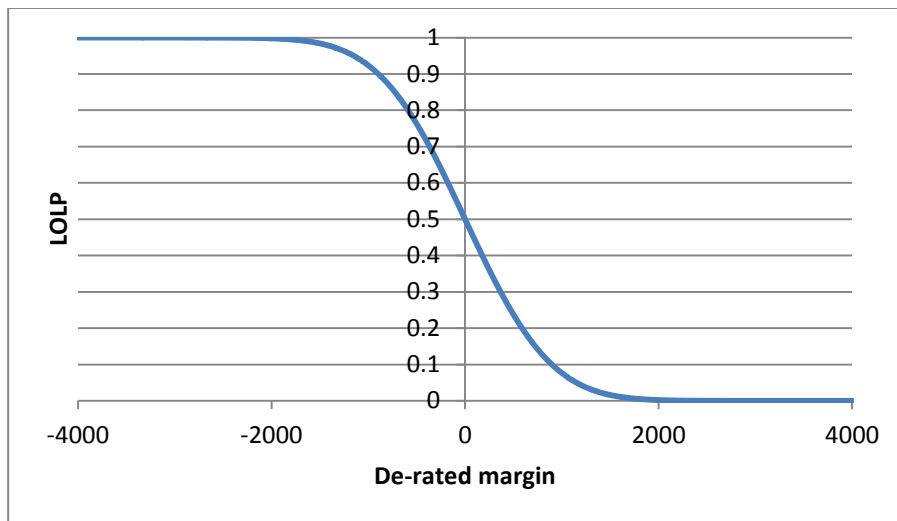
Where:

DRM: is the De-rated Margin – see Section 5 below;

$\mu = 0$ ; and

$$\sigma^2 = 700\text{MW}$$

Based on this mathematical relationship, the Transmission Company produces a lookup table that enables Parties to determine LoLP values based on a de-rated margin value. A copy of this lookup table is publicly available which Parties can find on the ELEXON Portal. The Transmission Company and BSCCo will work together to ensure the lookup table is maintained and contains up-to-date details, including any revisions to the definition of the Static function.



From the graph above it is clear that at 0MW of de-rated margin (note that at this point the only margin remaining is reserve for response which cannot be depleted) the LoLP value is 0.5. This is because when there is expected to be no de-rated margin available at Gate Closure there is statistically a 50:50 chance that there will be sufficient generation during the Settlement Period to meet demand i.e. because demand could reduce or generation increase or vice versa.

#### 4.5 Review of Static LoLP function and look-up table

Until 1 November 2018, by the fifteenth working day of each December, the Transmission Company will produce and send to the BSCCo a revised Static function and lookup table.

To do this, the Transmission Company will record historical values of LoLP using its Dynamic Method (see Section 6) and de-rated margin (see Section 5), for the calendar year that has just passed. The Transmission Company will add this historical data to any existing historical data used to calculate Static LoLP Functions(s). The Transmission Company will use this enlarged data set to determine an updated relationship between LoLP and de-rated margin and generate an updated Static LoLP Function and lookup table.

Upon receipt from the Transmission Company, the BSCCo will publish the revised Static LoLP Function and lookup table on the ELEXON Portal by the end of the same December. This is to give BSC parties three months' notice before the revised function and lookup table take effect on 1 April each year.

## 5. De-rated Margin

### 5.1 Overview

The Transmission Company will produce values of de-rated margin at specific lead times ahead of a Settlement Period. The Transmission Company uses De-rated Margin values to calculate LoLP values in accordance with the Static LoLP Function Method – see Section 4.

### 5.2 Method for calculating De-rated Margin values

For a given Settlement Period, the Transmission Company will calculate the de-rated margin value by determining the Combined Generation Forecast and subtracting the Capacity Requirement (CR). This can be represented using:

$$\text{De-rated Margin (DRM}_j) = Z_j - \text{CR}_j$$

Where:

$Z_j$ : is the Combined Generation Forecast ( $Z$ )

$$= X_j + U_j$$

Where:

$X_j$ : is the Conventional Generation Forecast

$$= \sum(\text{GCAP}_{ij} \times \text{AV}_i)$$

$\text{GCAP}_{ij}$ : is the Generation Capacity of a conventional generator – see 3.2

$\text{AV}_i$ : is an Availability Factor – see 3.3

$U_j$ : is the sum of BMU Wind Generation Forecasts for that Settlement Period as reported on BMRS - see 3.5 above

$$= \sum(W_{\text{fcst}_j})$$

$\text{CR}_j$ : is the Capacity Requirement – see 3.4

It should be noted that the calculation of De-rated Margin uses the sum of BMU Wind Generation Forecasts ( $U_j$ ) rather than the Total Wind Generation Forecast ( $W_j$ ) which is used for calculating a LoLP value using the Dynamic Method.

### **5.3 Frequency of calculating and publishing De-rated Margin values**

For each Settlement Period, the Transmission Company will calculate and send to the BMRA forecast De-rated Margin values at specific lead times ahead of the Settlement Period commencing.

In particular, the Transmission Company will calculate De-rated Margin values in accordance with 3.6 (a), (b) and (c).

## 6. Dynamic Loss of Load Probability Function Method

### 6.1 Overview

The Dynamic LoLP Function Method (the ‘Dynamic method’) will be used by the Transmission Company to produce Indicative LoLP values from 1 May 2018 and Final LoLP values from 1 November 2018.

### 6.2 Method for calculating dynamic LoLP values

For a given Settlement Period, the dynamic model uses a direct relationship between the available generation ( $Z$ ) and the Capacity Requirement ( $CR$ ) and is defined as:

$$\text{LoLP}_j = P(Z_j - CR_j < 0)$$

Where:

Combined Generation Forecast ( $Z_j$ )

$$= X_j + W_j$$

Where:

$X_j$ : is the Conventional Generation Forecast

$$= \sum(GCAP_{ij} \times AV_i)$$

$GCAP_{ij}$ : is the Generation Capacity of a conventional generator – see 3.2

$AV_i$ : is an Availability Factor – see 3.3

$W_j$ : is the Total Wind Generation Forecast – see 3.5 above.

$CR$ : is the Capacity Requirement

It should be noted that the calculation of a LoLP value using the Dynamic Method uses the the Total Wind Generation Forecast ( $W_j$ ) rather than the sum of BMU Wind Generation Forecasts ( $U_j$ ) which is used for calculating a De-rated Margin value.

### **6.3 Frequency of calculating and publishing Final and Indicative LoLP values**

For each Settlement Period from 1 May 2018, the Transmission Company will calculate and send to the BMRA Indicative LoLP values in accordance with the Dynamic method at the specific lead times set out in 3.6 (a) and (b) above.

For each Settlement Period from 1 November 2018, the Transmission Company will calculate and send to the BMRA Final LoLP values in accordance with the Dynamic method at the specific lead time set out in 3.6 (c) above – i.e. at Gate Closure

If for whatever reason the Transmission Company cannot produce an Indicative or Final LoLP value, it will report a ‘null’ value for that lead time. If no Indicative or Final LoLP value is received by the BMRA for a particular lead time, the BMRA will consider the value for that lead time to have been reported as ‘null’.

If the Transmission Company reports a Final LoLP value as ‘null’ to the BMRA, the BMRA will use the most recent Indicative LoLP as the Final LoLP. For example, the 2 hour ahead Indicative LoLP or if that is not available the 4 hour ahead Indicative LoLP, etc.