

ELECTRICITY INDUSTRY ACT 2004

ELECTRICITY INDUSTRY (WHOLESALE ELECTRICITY
MARKET) REGULATIONS 2004

WHOLESALE ELECTRICITY MARKET RULES

Market Procedure for: Determining Loss Factors

Commencement: This Market Procedure is to have effect from 8:00am (WST) on the same date as the Wholesale Electricity Market Rule, in which this procedure is made in accordance with, commences.

Market Procedures Published by the Minister

I, FRANCIS LOGAN, Minister for Energy for the State of Western Australia, under regulation 9(2) of the *Electricity Industry (Wholesale Electricity Market) Regulations 2004* hereby approve the publication of the Loss Factors Procedure contained in this document.

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Dated at Perth this day of 2006.

1. Loss Factors Procedure

The Loss Factors Procedure covers the process for determining Loss Factors. The methodology to be applied by Network Operators in calculating Loss Factors is described. The procedure includes steps to be followed by Network Operators and the IMO, and the process for Market Participants seeking a reassessment of a Loss Factor.

This procedure is made in accordance with Market Rule 2.27.6.

1.1 Interpretation

In this procedure, unless the contrary intention is expressed:

- (a) terms used in this procedure have the same meaning as those given in the Wholesale Electricity Market Rules (made pursuant to the Electricity Industry (Wholesale Electricity Market) Regulations 2004);
- (b) to the extent that this procedure is contrary or inconsistent with the Market Rules, the Market Rules shall prevail to the extent of the inconsistency;
- (c) a reference to the Market Rules or Market Procedures includes any associated forms required or contemplated by the Market Rules or Market Procedures; and
- (d) words expressed in the singular include the plural or vice versa.

1.1A Definitions

In this Market Procedure the following terms have the following meanings:

“**Access Contract**” has the meaning given to it in the Electricity Networks Access Code 2004.

“**Connection Point**” has the meaning given to it in the Electricity Networks Access Code 2004.

“**Distribution System**” has the meaning given to it in the Electricity Networks Access Code 2004.

“**Entry Point**” has the meaning given to it in the Electricity Networks Access Code 2004.

“**Exit Point**” has the meaning given to it in the Electricity Networks Access Code 2004.

“**Peak Demand**” means the Contracted Maximum Demand (CMD) for an Exit Point declared in an Access Contract, or where no CMD is declared, it means the peak demand that is likely to

occur at an exit point over a 12 month period as determined by the Network Operator, acting as a reasonable and prudent person.

“Peak Generation” means the Declared Sent Out Capacity (DSOC) for an Entry Point declared in an Access Contract, or where no DSOC is declared, it means the peak generation that is likely to occur at an exit point over a 12 month period as determined by the Network Operator, acting as a reasonable and prudent person.

“Reference Service” has the meaning given to it in the Electricity Networks Access Code 2004.

“Transmission System” has the meaning given to it in the Electricity Networks Access Code 2004.

“Western Power” means the Electricity Networks Corporation established under the Electricity Corporations Act 2005.

1.2 Overview

Loss Factors are used to allocate system losses and to provide an economic signal for customers to use the system efficiently. While system losses can be measured in total, losses due to any specific user cannot be measured. The methodology in this Loss Factors Procedure seeks to allocate losses to users in an equitable manner.

The Market Rules does not define a Connection Point and does not differentiate between loss factors for Connection Points on the Distributions System or the Transmission System. However, consistent with the NEM, this procedure requires a Loss Factor shall be calculated as a transmission loss factor (TLF) multiplied by a distribution loss factor (DLF) where the TLF represents relevant marginal losses on the transmission system and the DLF represents relevant average losses on the distribution system. Further, different average DLFs shall be calculated for different Reference Services for small end users to take into account the Distribution System equipment which is typically used to supply users of particular Reference Services.

1.3 Procedure steps to be followed by Network Operators

- 1 Network Operators must annually revise the data used to calculate Loss Factors. The data will comprise generation and load data for a 12 month period preceding the calculation of the Loss Factors.

- 2 By 1 June of each year, Network Operators must calculate Loss Factors, based on its annual revised data, and provide these to the IMO. (Market Rule 2.27.1)
- 3 To the extent that there is a change of more than 0.025 in any Loss Factor compared to the Loss Factor of the previous year, the Network Operator is to provide the IMO with a written explanation of the change. The written explanation is to be provided to the IMO at the same time as the Loss Factor to which it pertains. The Network Operator may, but is not required to, provide to the IMO a written explanation to accompany any other Loss Factor calculated. The written explanation provided under this clause will have the confidentiality status of Public.
- 4 Network Operators are required to calculate Loss Factors for any Facility, Dispatchable Load and Non-Dispatchable load. (Market Rule 2.27.1)
- 5 The majority of the Connection Points outlined in Step 4 will use average Loss Factors. The same Loss Factor will apply to groups of Non-Dispatchable Loads less than 10,000kVA Peak Demand. The Network Operator may group Non-Dispatchable Loads less than 10,000kVA Peak Demand by Reference Service or equivalent method.
- 6 A single Loss Factor is to be determined for each Connection Point. The Network Operator may specify a separate transmission Loss Factor and distribution Loss Factor for each Connection Point. The single Loss Factor for the Connection Point is calculated by multiplying the applicable transmission Loss Factor by the applicable distribution Loss Factor.
- 7 In calculating Loss Factors, Network Operators must apply the principles outlined in Market Rule 2.27.2 and the methodology outlined in Section 1.5 of this procedure.

1.4 Procedure steps to be followed by the IMO

This section applies to annual review and interim publication of loss factors.

- 1 As soon as practicable, but no later than two Business Days after receiving Loss Factors from Network Operators, the IMO must publish the Loss Factors on its website. (Market Rule 2.27.3) In the event that the IMO also receives a written explanation from the Network Operator accompanying the Loss Factors, the IMO will publish the explanation on its website.
- 2 In addition to the Loss Factors, the IMO must publish the Trading Day on which the relevant Loss Factors will commence. In determining the commencement date, the IMO will have regard to the time requirements for Market Participants to identify and update

Standing Data dependent on the relevant Loss Factors. (Market Rules 2.27.3A and 2.27.3B)

1.5 Transmission Loss Factor Methodology

The following methodology is to be used by Network Operators for calculating Loss Factors:

- 1 Loss Factors shall be calculated for every Connection Point on the Transmission System. It should be noted that the definition of a Connection Point is consistent with the concept of a virtual transmission node in the NEM, in that it may be an Entry Point or an Exit Point identified in an Access Contract and may contain a group of physical transmission connections.
- 2 Where a user has multiple physical connections at the same transmission node, diversification of their network usage shall be recognised. Where a user's multiple physical connections are all normally electrically connected at the same transmission node, entry data for each connection may be summated and exit data for each connection may be summated in each trading interval (entry and exit values shall not be netted against each other) and separate entry and exit loss factors calculated from which a single loss factor shall be calculated for the single virtual Connection Point as a whole. The single Loss Factor shall be applicable to each physical connection.
- 3 Where it is necessary to calculate separate loss factors either for multiple physical connections (either entry or exit or combination) at the same transmission node or for entry and exit on the same physical connection, and it is necessary to determine a single loss factor for a user for a connection, a single loss factor shall be calculated as an energy weighted average of the individual loss factors. For example, if a Connection Point is used for both entry and exit in different trading intervals a single loss factor for that Connection Point shall be calculated from an energy weighted average of the separate entry and exit loss factors calculated for that Connection Point.
- 4 A Network Operator must compile network load and generation information, for each trading interval, for the 12 month period from 1 April to 31 March immediately preceding its Loss Factor calculations. This information is to be compiled via an industry standard program and sufficiently documented to allow for it to be reviewed should the information become subject to an IMO audit. If a raw data point for any interval has been tagged with a quality flag, the point may be interpolated using straight line estimation from data over adjacent trading intervals. In order to reduce gross error from bad data or outliers, any trading interval where the total generation on the SWIS does not equal the total load $\pm 10\%$ that $\frac{1}{2}$ hour shall be excluded.

- 5 A Network Operator will assign to each Load and Generation bus a Bus number. The Network Operator must have in place processes for administering and updating, as required, the Load and Generation Bus numbers.
- 6 A Network Operator must compile network topology information that reflects the actual system configuration, impedance and state, using an industry standard program. The base load flow case shall include as commissioned equipment at the 31st March in the relevant year and be representative of the typical system operating state consistent with the Western Power Drawing No TS1 (Transmission System Diagram). The information must be sufficiently documented to allow for it to be reviewed should the information become subject to an IMO audit.
- 7 At the close of the relevant 12 month period, the Network Operator must produce the network load and generation information and the network topology information, formatted in such a way that the information can be used by an appropriate industry standard program, such as Transmission Pricing Program (TPRICE), to calculate Loss Factors.
- 8 The Network Operator must have in place processes to examine the information files for errors, including missing or erroneous data. The Network Operator must have in place processes for reloading the correct information and recalculating data, as required, including a process to check that any error or changes required have been fixed.
- 9 The Network Operator will use an appropriate industry standard program, such as TPRICE, to calculate Loss Factors, using the network load and generation information and the network topology information inputted.
 - The TPRICE algorithm can be summarized as:
 - a load flow is solved for each trading interval using the supplied generation and load data from the 12 month period immediately preceding the calculation;
 - the marginal Loss Factors defined with respect to the load flow swing bus are calculated for each Connection Point and trading interval;
 - the marginal Loss Factors defined with respect to the Reference Node are calculated for each trading interval as the ratio of the Connection Point Loss Factor to the Reference Node Loss Factor.
 - for each Connection Point, the marginal Loss Factors (with respect to the Reference Node) for each trading interval are volume weighted by Connection

Point marginal Loss Factors (with respect to the Reference Node) to give the static marginal Loss Factor.

- 10 Loss Factors for the Transmission System must represent the marginal losses for a Connection Point relative to the Reference Node, averaged over all Trading Intervals in the 12 month period immediately preceding the Loss Factor calculation, weighted by the absolute value of the net demand at that Connection Point during the Trading Interval. (NB Transmission Loss Factors shall represent losses for the Transmission System only and as such, in Tprice loadflow models, the impedance of generator step-up transformers and the reactance of the generators themselves shall be set close to zero (eg. 0.0001pu) so as not to have any effect on the calculation of the fault contribution matrices. Fault contribution matrices are used to allocate actual marginal load and generation.)
- 11 The Network Operator must have in place internal procedures and business processes for calculating Loss Factors.
- 12 The Network Operator must sufficiently document all its models, procedures, processes and methodologies used to calculate Loss Factors to allow for these to be reviewed should the Loss Factor calculations become subject to an IMO audit.

The models, procedures, processes and methodologies used to calculate Loss Factors must be provided to the IMO by the Network Operator no later than 5 Business Days following the commencement of this Procedure. The IMO must publish the models, procedures, processes and methodologies as soon as practicable on its Web Site.

Any subsequent change proposed to the models, procedures, processes and methodologies used to calculate Loss Factors must be provided to the IMO by the Network Operator and published by the IMO as soon as practicable. The Network Operator must allow sufficient time for the IMO to review the change and seek comments from Market Participants on the change before the change is implemented.

- 13 Western Power must calculate energy weighted average Loss Factors for the Transmission System representing a system wide average and an urban average. The Urban average is based on substations within the CBD and Urban pricing zones as detailed in Western Power's Price List.

1.5A Distribution Loss Factor Methodology

1. Western Power must calculate a system wide average Loss Factor for the Distribution System
2. Western Power must calculate uniform average Loss Factors for the following Reference Services:
 - a) A1 – Anytime Energy (Residential) Exit Service
 - b) A2 – Anytime Energy (Business) Exit Service
 - c) A3 – Time of Use Energy (Small) Exit Service
 - d) A4 – Time of Use Energy (Large) Exit Service
 - e) A5 – High Voltage Metered Demand Exit Service
 - f) A6 – Low Voltage Metered Demand Exit Service
 - g) A9 – Streetlighting Exit Service
 - h) A10 – Un-Metered Supplies Exit Service

Uniform distribution loss factors are to be determined by allocation of the measured annual losses on the distribution network to each of the reference services based on their relative use of the various network assets.

3. Where required, an individual distribution loss factor for an exit point is to be calculated using the following methodology:
 - (a) The Network Operator must determine the line losses assuming the distribution exit point was not there and assuming feeder maximum load;
 - (b) The Network Operator must determine the line losses assuming only the distribution exit point was there and assuming feeder maximum load;
 - (c) The Network Operator must determine the total line losses assuming all the distribution connection points are there (including the distribution exit point for which the loss factor is being determined) and assuming feeder maximum load;
 - (d) The Network Operator must allocate a share of the total line losses calculated under step (c) to the distribution exit point for which the loss factor is being determined based on the ratio of the result of step (b) and the sum of the results of steps (a) and (b);
 - (e) The Network Operator must calculate the loss factor for the distribution exit point by applying the following formula:

$$LF_{Exit} = 1 + \frac{A}{B}$$

where —

- A (in kW) is the share of the total line losses allocated to the distribution exit point under step (d);
- B (in kW) is the contract maximum demand for the distribution exit point.

4. Where required, a individual distribution loss factor for an entry point is to be calculated using the following methodology:
- (a) The Network Operator must determine the line losses assuming the distribution entry point was not there and assuming feeder maximum load;
 - (b) The Network Operator must determine the total line losses assuming all the distribution connection points are there (including the distribution entry point for which the loss factor is being determined) and assuming feeder maximum load;
 - (c) The Network Operator must calculate the loss decrease or increase for the distribution entry point for which the loss factor is being determined by subtracting the result of step (b) from the result of step (a);
 - (d) The Network Operator must calculate the loss factor for the distribution entry point by applying the following formula:

$$LF_{Entry} = 1 + \frac{A}{B}$$

where —

- A (in kW) is the loss increase or decrease calculated for the distribution entry point under step (c);
- B (in kW) is the declared sent-out capacity for the distribution entry point.

1.6 Reference Node

For the purpose of this procedure and in accordance with the Market Rules, the Transmission System Reference Node shall be the Muja 330 bus-bar.

For calculating loss factors in Tprice, the nominated swing bus shall be the 200MW G6 machine at Kwinana Power Station.

1.7 Notional Wholesale Meters

Where a Loss Factor is to apply to a Notional Wholesale Meter, the Loss Factor will be the Transmission System system wide average Loss Factor multiplied by the Distribution System system wide average Loss Factor.

1.8 Connection Points on Western Power's Distribution System

The following rules apply when assigning transmission and distribution Loss Factors to Connection Points on the Western Power Distribution System.

1.8.1 Transmission Loss Factors

For Connection Points on the Distribution System operated by Western Power the following rules apply in determining the applicable transmission Loss Factor:

a) For an Exit Point contracted on any of the following Reference Services the system wide average must be applied as the transmission Loss Factor:

- i) A1 – Anytime Energy (Residential) Exit Service
- ii) A2 – Anytime Energy (Business) Exit Service
- iii) A3 – Time of Use Energy (Small) Exit Service
- iv) A4 – Time of Use Energy (Large) Exit Service
- v) A5 – High Voltage Metered Demand Exit Service
- vi) A6 – Low Voltage Metered Demand Exit Service
- vii) A9 – Streetlighting Exit Service
- viii) A10 – Un-Metered Supplies Exit Service

or

b) For an Exit Point on the Distribution System not contracted onto the Reference Services listed in section 1.8.1(a) with Peak Demand less than 1,000 kVA the system wide average must be applied as the transmission Loss Factor; or

c) For an Exit Point on the Distribution System not contracted onto the Reference Services listed in section 1.8.1(a) with Peak Demand greater than or equal to 1,000 kVA and the:

- i) associated substation identified in an Access Contract; or
- ii) the electrically closest substation (if a substation is not identified in the Access Contract)

is in the Urban and CBD pricing zones the urban average must be applied as the transmission Loss Factor; or

d) In all other instances the transmission Loss Factor is the transmission Loss Factor assigned to the

- i) associated substation identified in an Access Contract; or
- ii) the electrically closest substation (if a substation is not identified in the Access Contract)

1.8.2 Distribution Loss Factors

For Connection Points on the Distribution System operated by Western Power the following rules apply in determining the applicable distribution Loss Factor:

a) For Connection Points contracted on the following Reference Services the associated uniform Loss Factor must be applied as the distribution Loss Factor:

- i) A1 – Anytime Energy (Residential) Exit Service
- ii) A2 – Anytime Energy (Business) Exit Service
- iii) A3 – Time of Use Energy (Small) Exit Service
- iv) A4 – Time of Use Energy (Large) Exit Service
- v) A5 – High Voltage Metered Demand Exit Service
- vi) A6 – Low Voltage Metered Demand Exit Service
- vii) A9 – Streetlighting Exit Service
- viii) A10 – Un-Metered Supplies Exit Service

or

b) For Exit Points not contracted onto the Reference Services listed in section 1.8.2(a) with Peak Demand less than 1,000 kVA the distribution Loss Factor must be applied as follows:

- i) if the Exit Point is connected to the Distribution System at low voltage (415 volts or less) and the Exit Point is located at a residential premise or a premise occupied by a voluntary/charitable organization the uniform Loss Factor associated with Reference Service A1 applies; or
- ii) if the Exit Point is connected to the Distribution System at low voltage (415 volts or less) and the Exit Point is located at a commercial premise the uniform Loss Factor associated with Reference Service A2 applies; or
- iii) if the Exit Point is connected to the Distribution System at high voltage (greater than 415 volts) uniform Loss Factor associated with Reference Service A5 applies;

or

c) For Exit Points not contracted onto the Reference Services listed in section 1.8.2(a) with Peak Demand between 1,000 kVA and 10,000 kVA inclusive the distribution Loss Factor must be applied as follows:

- i) if the Connection Point is connected to the Distribution System at high voltage (greater than 415 volts) the uniform Loss Factor associated with Reference Service A5; or
- ii) if the Connection Point is connected to the Distribution System at low voltage (415 volts or less) the uniform Loss Factor associated with Reference Service A6.

or

d) For Exit Points with Peak Demand greater than 10,000 kVA or with actual or forecast consumption of more than 40 GWh per annum the Network Operator must calculate an individual distribution Loss Factor;

or

e) For Entry Points on the Distribution System with Peak Generation greater than 10,000 kVA the Network Operator must calculate an individual distribution Loss Factor.

or

f) For Entry Points on the Distribution System with Peak Generation less than or equal to 10,000 kVA the Market Participant may choose between:

- i) if the Connection Point is connected to the Distribution System at high voltage (greater than 415 volts) the uniform Loss Factor associated with Reference Service A5; or
- ii) if the Connection Point is connected to the Distribution System at low voltage (415 volts or less) the uniform Loss Factor associated with Reference Service A6; or
- iii) if the Market Participant meets the reasonable cost of Western Power in performing the necessary calculation then Western Power must calculate an individual distribution Loss Factor.

1.8.3 Changes in Nominated Reference Service

When the nominated Reference Service for a Connection Point is changed the Network Operator must re-determine the transmission and distribution loss factors in accordance with sections 1.8.1 and 1.8.2. The new transmission and distribution loss factors apply from the date the Reference Service change is effective.

1.8.4 Individually Calculated Distribution Loss Factors

This section applies where an individual distribution loss factor is required under section 1.8.2 (d), (e) or (f).

If a new Connection Point is commissioned during the year and is:

- (a) eligible for an individual distribution loss factor under section 1.8.2 (d) or (e); or
- (b) the Market Participant elects an individual distribution loss factor under section 1.8.2 (f)

the Connection Point will be assigned the distribution loss factor calculated by the Network Operator and the commencement date will be determined by the later of:

- (a) the first trading day following commissioning of the Connection Point; or
- (b) the trading day determined by the IMO under section 1.4 (2).

The IMO will publish the new loss factor in accordance with section 1.4.

The Network Operator must review individual distribution loss factors during annual reviews in accordance with this market procedure.

The cost of calculating and annually reviewing individual distribution loss factors will be borne by the Network Operator except where a Market Participant has elected to apply an individual distribution loss factor under section 1.8.2 (f). In this instance loss factor calculation and reviews (including annual) will be at the expense of the Market Participant.

1.9 Re-assessment of Loss Factors (Market Rule 2.27.4)

Where a Market Participant reasonably believes that a Loss Factor is in error, it may apply to the IMO for reassessment.

A Market Participant may seek re-assessment for any Loss Factor applying to a:

- Scheduled Generator registered by the Market Participant;

- Non-Scheduled Generator registered by the Market Participant;
- Curtailable Load registered by the Market Participant;
- Interruptible Load registered by the Market Participant;
- Dispatchable Load registered by the Market Participant;
- Non-Dispatchable Load registered by the Market Participant.

The following procedure applies to re-assessment of Loss Factors:

Market Participant Notification

- 1 Within 15 Business Days of the IMO publishing a Loss Factor, the Market Participant must notify the IMO, in writing via email, if it believes the Loss Factor to be in error. The notification must outline:
 - the Loss Factor believed to be in error; and
 - the Market Participant's reasons for believing the Loss Factor should be a different value.

IMO Audit

- 2 Within two Business Days of receipt of the Market Participant's notification, the IMO must notify the relevant Network Operator that it will be carrying out an audit of the Loss Factor calculation. The notification will outline:
 - the Loss Factor believed to be in error;
 - a request for access to the relevant data and calculations used in producing the Loss Factor. The request may include:
 - provision of written information to the IMO by the Network Operator;
 - access to the Network Operator's premises, systems and personnel for the IMO to review relevant data and calculations, including the Network Operator providing a demonstration of any systems and processes used to calculate Loss Factors or replication of the process used to calculate the Loss Factors at issue;

- a date by which the Market Participant is to comply with the request. Such a date will be no less than five Business Days from the date of the IMO notification.
- 3 The IMO may, as it sees fit, institute any one or more of the following levels of audit:
 - Level 1 – reviewing the reasons provided by the notifying Market Participant for believing the Loss Factor should be a different value and/or reasons provided by the Network Operator for the Loss Factor value as calculated;
 - Level 2 – reviewing or analysing the data used to calculate the Loss Factor;
 - Level 3 – reviewing, replicating, or rerunning the models or calculation processes used to calculate the Loss Factor.
 - 4 The IMO may, at its discretion, aggregate its audit of Loss Factor calculations that are the subject of Market Participant notifications, provided the IMO adheres to the timing parameters outlined in the Market Rules and this procedure for each individual Market Participant notification.

Network Operator Cooperation

- 5 The relevant Network Operator is required to cooperate with an IMO audit of any Loss Factor calculation, including provision of access to the data, systems, calculations and personnel used in producing the Loss Factor.

Discovery of Error

- 6 Where an audit reveals an error in a Loss Factor calculation, the IMO will direct the relevant Network Operator to recalculate the Loss Factor. The IMO may also direct the Network Operator to recalculate any other Loss Factors, where the IMO is of the view that a recalculation is warranted.
- 7 The Network Operator must provide the recalculated Loss Factor, or Loss Factors as the case may be, to the IMO as soon as practicable from receipt of the IMO's direction to recalculate.

Cost of Audit

- 8 Where an audit reveals a material error in the Loss Factor which was the subject of an audit (eg. error of more than 0.0025), the Network Operator shall pay the costs of the audit. Otherwise the Market Participant whom initiated the audit shall pay all relevant costs for the audit, including those of the Network Operator.

Publication of revised Loss Factors

- 9 On receipt of any recalculated Loss Factor, the IMO must publish the revised Loss Factor and the applicable Trading Day on which the revised Loss Factor commences.

1.10 Failure to provide Loss Factors

In the event a Network Operator fails to provide the IMO with a Loss Factor, as required in accordance with this procedure or the Market Rules, the IMO will use the equivalent Loss Factor from the previous year.

Where a Network Operator subsequently provides an updated Loss Factor, the previous year Loss Factor will continue to apply until the commencement of the applicable Trading Day published by the IMO for the updated Loss Factor. (Market Rule 2.27.5)

1.11 New Substations

If a new substation is commissioned during the year, it will be assigned the same loss factor as that of the electrically closest substation until the Network Operator calculates loss factors as detailed in section 1.3.