AUDIT OF ONESTEEL'S PROPOSED DISTRIBUTION LOSS FACTORS FOR 2007/08

A Report to IPART

19 September 2007

IES
Intelligent Energy Systems

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As was indicated in our proposal to the Independent Pricing and Regulatory Tribunal of New South Wales, Intelligent Energy Systems (IES) has made use of the most reliable information it has been able to source. This information consists of documents sourced from OneSteel Limited and discussions with the same and from the National Electricity Rules as at September 2007. In addition, all reasonable steps were undertaken to identify the authenticity of these documents.

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Executive Summary

The Independent Pricing and Regulatory Tribunal of NSW (the Tribunal) has commissioned Intelligent Energy Systems (IES) to review the Distribution Loss Factors (DLFs) proposed by OneSteel Limited (OneSteel) for its customers Delta EMD and Donhad Pty Ltd. The scope of the brief is to:

- Assess the suitability of the methodology used;
- Determine whether the distribution loss factors have been calculated according to this methodology;
- Where necessary, consult with OneSteel to clarify information, obtain additional information, and discuss any revision to its proposal;
- Provide the Tribunal with a written report that assesses OneSteel's submission and makes recommendations on the appropriateness of its proposed DLFs for 2007/08.

IES has reviewed the submission received from OneSteel and has had further communications with its personnel where clarification was required.

DLFs are discussed in Sections *3.6.3* and *6.13.2* of the National Electricity Rules (the Rules). Important points outlined in the Rules and considered during the current review process, amongst other things, are:

- calculation of an average distribution loss factor for energy losses for electricity transmitted between a distribution network connection point and a transmission network connection point or virtual transmission node;
- use of the most recent actual load and generation data available for a consecutive 12-month period, or adjusting the load and generation data to get projected values for the financial year in which the DLFs will apply.

The Tribunal has provided IES with its document titled "Assessment and Approval of Distribution Loss Factors proposed by DNSPs" which details the Rules relating to DLFs and its approved calculation methodology.

The following summary includes an overview of the audit process and our recommendations regarding OneSteel's proposed DLFs for financial year 2007/08.

Overview

OneSteel submitted two spreadsheets showing the calculation of its DLFs for the Delta EMD (NMI 7102000007) and the Donhad Pty Ltd (NMI 7102000008) sites. These are site specific customers connected at the 33kV and 11kV voltage levels, respectively, within OneSteel's distribution network located in Mayfield, Newcastle.

OneSteel also provided a supporting document in its letter to the Tribunal titled "OneSteel Limited Exempt Network – Application for approval of Distribution Loss Factors on OneSteel's Mayfield Site" dated 20 August 2007, which details its proposed DLFs and the methodologies used for its DLF calculations. These methodologies are outlined in the body of the report (see Section 3.3).

OneSteel's Proposed DLFs for 2007/08

For site specific customers, a DLF is interpreted as the amount of energy required to supply the customer with 1 unit of energy.

The DLF proposed for its customer Delta EMD is 1.005774, and for Donhad Pty Ltd it is 1.01148.

Recommendations

OneSteel has provided IES with two spreadsheets showing the calculation of each of its proposed DLFs. IES considers the calculation procedures employed to be consistent with the Rules and following the Tribunal's approved methodology.

Given that the input values provided in OneSteel's supporting spreadsheets are correct, the calculation methodologies have been applied correctly in determining DLF values.

For the Delta EMD site, connected at 33kV, shunt and series losses are calculated from first principles. The calculations are carried out by month using the most recent 12 months of historical financial year data, that is, from July 2006 to June 2007. OneSteel has provided a sample calculation of losses in its supporting document and has confirmed that the same procedure was followed for each month in financial year 2006/07.

Delta EMD's DLF is then calculated as 1 plus losses divided by load for financial year 2006/07.

For Donhad Pty Ltd, the DLF is calculated using the net energy supplied to OneSteel's distribution network (excludes that for Delta EMD measured at the distribution network boundary) and the net metered load at the customer connection points (again, excludes Delta EMD).

The DLF for Donhad Pty Ltd is then calculated as the net energy supplied to OneSteel's distribution network divided by the net customer load.

In summary, the proposed DLFs for Delta EMD and Donhad Pty Ltd:

- make use of the most recent actual load and generation data available for a consecutive 12-month period, that is, financial year 2006/07, as specified by the Rules;
- are consistent with the Tribunal's approved methodology; and

- represent the average energy losses for electricity transmitted between a transmission network connection point and the distribution network connection point for the customer's site, as required by the Rules.

OneSteel wishes to apply its proposed DLFs retrospectively, that is, from 1 April 2007 when OneSteel assumed responsibility for the supply of electricity within its distribution network. Given that the network has not undergone any major upgrades or changes to its structure since then, IES considers the proposed DLFs to be a reasonable estimate of losses as of 1 April 2007.

IES recommends that OneSteel's proposed DLFs for its customers Delta EMD and Donhad Pty Ltd are accepted as is and applied in financial year 2007/08, and retrospectively from 1 April 2007.

In future years it would be worthwhile for OneSteel to check that the DLFs applied in a financial year (approximately) capture the actual losses for that year. OneSteel should review its methodology where there is found to be a significant discrepancy between the actual losses and the losses implied by a customer's DLF.

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1 Introduction

The National Electricity Rules (the Rules) requires that distribution loss factors (DLFs) must be calculated initially, and then reviewed on an annual basis, by each distribution network service provider (DNSP). The Independent Pricing and Regulatory Tribunal (the Tribunal), as the jurisdictional regulator in NSW, must approve the calculated values for that state. The DNSPs must provide the approved DLFs to NEMMCO by 1 April each year to apply for the financial year commencing 1 July of that year.

The Tribunal has commissioned Intelligent Energy Systems (IES) to carry out the review of OneSteel Limited's (OneSteel's) proposed DLFs for the financial year 2007/08. The scope of the brief is to:

- Assess the suitability of the methodology and that it is consistent with the Tribunal's approved methodology as detailed in its document "Assessment and Approval Process of Distribution Loss Factors proposed by DNSPs";
- Determine whether the distribution loss factors have been calculated according to this methodology;
- Where necessary, consult with OneSteel to clarify information, obtain additional information, and discuss any revision of its proposal;
- Provide the Tribunal with a written report that assesses OneSteel's proposal and makes recommendations on appropriate DLFs if required.

1.1 Approach Taken

Assignment of loss factors to different customers or classes of customers is dependent on the losses associated with the usage of network assets utilised in the supply of electricity to those customers. Total losses must be suitably apportioned to the different groups.

Estimation of losses in different parts of a network can depend on load flow studies, calculations from first principles, metering, or other analyses of the power system. Under the limited scope of the brief, we have not attempted a detailed audit of those studies. Instead we have focused on the use of the study results in deriving appropriate loss factors for OneSteel's customers.

As such, IES has reviewed the spreadsheets submitted by OneSteel in the context that the input data contained in the spreadsheets is assumed to be correct. IES has reviewed the spreadsheets for the suitability of the methodology applied and, given that the methodology is appropriate, the correct use of the input data in the calculation of OneSteel's proposed DLFs for financial year 2007/08.

1.2 Report Overview

The main body of the report contains the following sections:

- an overview of distribution systems and a general DLF calculation methodology;
- a review of OneSteel's submission with IES' recommendations; and
- the relevant parts of the Rules reproduced in an Appendix.

2 Overview of Distribution Loss Factors

2.1 Rule Requirements for DLFs

The National Electricity Rules' requirements for distribution loss factors, as defined in Clause 3.6.3 of that document, are reproduced in Appendix A. Some points from the Rules are summarised below.

- The clear requirement is that they be *average* loss factors, in the sense that application of the factors to the loads to which they apply should, as far as practicable, equal the losses actually incurred. They differ from transmission loss factors, which are defined to approximate marginal losses. Transmission loss factors produce a financial surplus when applied to settlements, whereas the intent of DLFs is that they should not. A reconciliation of actual losses with the losses implied by the application of DLFs, is therefore an important requirement for compliance with the Rules.
- The Rules does not specify how DLFs are to be expressed. However, the usual, and we believe correct, practice is to define loss factors as the ratio of the losses allocated to an end-user (or producer) and the metered load of that end-user (or producer). DLFs are usually expressed in a way that includes the metered load. For example, a loss factor of 1.05 implies that for each one unit supplied and metered there are 0.05 units or 5% dissipated in the distribution network. Sometimes the DLF is expressed simply as the loss percentage.

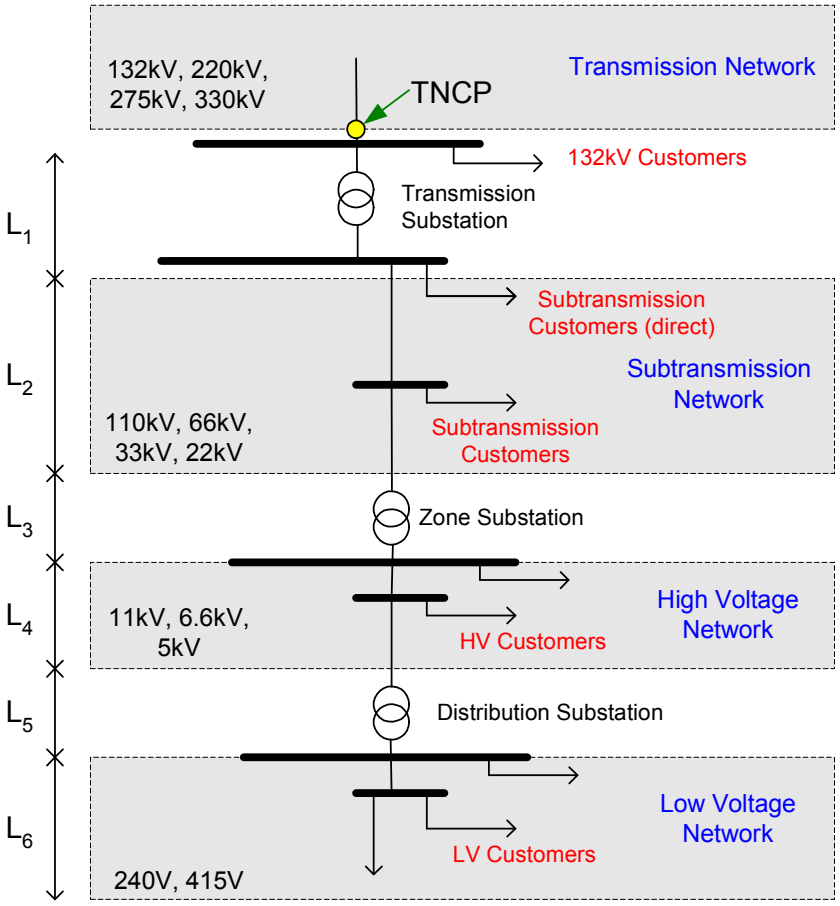
2.2 Organisation of Distribution Systems

The calculation of DLFs relies on assessing the losses in various distribution assets as energy passes through the distribution network from the points of supply to the points of consumption. Distribution networks are constructed as a hierarchy, with high voltages applying close to the points of supply and stepping down to lower voltages for the supply to smaller customers. Customers may take supply at any of these voltage levels. Figure 1 presents a simplified view of the distribution network to clarify the stages at which the losses L_1, L_2, L_3, etc, are incurred and calculated.

The Transmission Network Connection Point (TNCP) is the point of transition from the Transgrid very high voltage transmission network to the distribution network. The transmission substation belongs to the distribution network and is the first of a series of substations that transforms the energy to lower voltage levels. The total energy supplied by Transgrid is measured at the TNCP. The total energy consumed is measured by end-user meters, many of which are read monthly or quarterly. Further, meters are not 100% accurate, meters may not be read for some reason, some supplies (eg. street lighting) may be unmetered, and some electricity may be 'stolen' or otherwise not accounted for. Thus the

estimation of losses is not a simple task, and their allocation to various parts of the network (and therefore to customers) depends much on engineering estimation involving many judgements.

Figure 1 Simplified Distribution System



A real distribution network may diverge from the simplified version illustrated to take account of more complex situations for example:

- Sections of the 132kV network after the TNCP at which energy is billed by Transgrid could be included within the distribution network;
- There could be more than one TNCP;
- The TNCP could feed directly into the 11/33/66kV network;
- 132/11kV zone substations could bypass the transmission substation;
- There could be embedded generation;
- There could be supply from or to neighbouring TNSPs.

Following injection into the network, energy passes through the various assets in the system incurring losses on the way. Customers can take their supply at any of the various levels, as illustrated.

2.3 Overview of the Generic Approach to Calculating DLFs

The loss factor calculations are generally done by:

- Estimating total losses, taking into account the possibility of unread meters and 'stolen' energy. This is usually calculated as metered supply at the transmission connection points plus embedded generation less metered usage for customers;
- Estimating, where possible, using some engineering approach, the losses incurred in each network element, or group of network elements (assets);
- Losses in the low voltage (LV) network are usually calculated as a residual (total losses less losses assigned elsewhere);
- Assigning the losses to customer groupings based on estimates of the use of the assets;
- Adjusting the outcome to reconcile estimated losses with actual losses, or expectations of actual losses;
- Expressing DLFs as the total losses incurred by the load divided by the load (expressed as a percent, e.g. 5%), or the ratio of the estimated input to the distribution network required to meet the specific load or group of loads (e.g. 1.05).

The process of adjustment can be performed in several ways. One is a simple scaling. Another is to allocate residual losses where the estimation of losses is considered most difficult, usually in the low voltage network. In the second approach, any errors in the other calculations accumulate in the "swing" assets.

Losses in the network are of two types:

- Series (or copper) losses arise from the resistance to electrical flow in the network and are proportional to the square of the power flow.
- Shunt (or iron) losses are a 'leakage' of energy (mainly associated with the connection of transformers and other equipment to the network) and occur regardless of the flow of power.

A specific issue is whether the DLF calculations should account for load shape. Load shape is relevant in that higher percentage losses tend to be incurred at times of higher load, because of the fact that fractional losses tend to increase with the loadings on network elements. The problem here is that load shape is often not known with any precision, although educated estimates can be made for various customer classes.

The common practice here is:

- For larger, half-hourly metered customers, attempt a reasonably accurate loss calculation by relating individual load with system load over many time periods, based on historical half-hour records. This results in a separate DLF for each customer. Alternatively, a load loss factor (LLF) may be used to estimate annual losses from losses calculated at the time of peak load on the system.
- It is usual to group remaining customers either into tariff classes or voltage levels (the former usually being an expansion of the latter) which form the best available groupings for loss calculation purposes. Losses are then estimated on this basis. Some DNSPs make estimates based on different periods of the day, such as peak, off-peak, shoulder, while others ignore this factor.

Adjustments could also be made based on the power factor of typical tariff classes relative to the average system power factor. This impacts most noticeably on public lighting that has a poor power factor.

2.4 Calculation Method Example

Once the energy flow in a distribution network has been considered, there are a number of methods by which distribution loss factors can be calculated. The methods are in effect equivalent, as long as losses are small compared to the energy used by the system at each voltage level.

The following example illustrates a simple application of one of the methods. General loss factors are calculated as the percent energy lost at each level of the network divided by the energy throughput (sales plus energy out) at that level. Losses and sales attributed to site specific customers are excluded from the tableau. Distribution loss factors are then the cumulative loss factor at each level, calculated using the formula in the Table 1. Note that here the DLF takes the form of a fraction.

Table 1 Losses expressed as Percentage of Energy Delivered

Network Level	Losses	Sales + Energy Out	General Loss Factor	Cumulative Loss Factor
Transmission Substation	L_1	T_1	$x_1 = L_1 / T_1$	x_1
Subtransmission Network	L_2	T_2	$x_2 = L_2 / T_2$	$(1+x_1)(1+x_2) -1$
Zone Substation	L_3	T_3	$x_3 = L_3 / T_3$	$(1+x_1)(1+x_2)(1+x_3) -1$
HV Distribution Network	L_4	T_4	$x_4 = L_4 / T_4$	$(1+x_1)(1+x_2)(1+x_3)(1+x_4) -1$
Distribution Substation	L_5	T_5	$x_5 = L_5 / T_5$	$(1+x_1)(1+x_2)(1+x_3)(1+x_4)(1+x_5) -1$
LV Distribution Network	L_6	T_6	$x_6 = L_6 / T_6$	$(1+x_1)(1+x_2)(1+x_3)(1+x_4)(1+x_5)(1+x_6) -1$

The simple calculation of the cumulative loss factor shown in Table 1 needs modification when the energy arriving at a lower level of the network arrives by significantly different paths. In this case, the combined cumulative loss factor is

the energy-volume-weighted sum of the cumulative loss factors for each possible path.

For example, if some of the energy arriving at the subtransmission level comes from embedded generation which is subject to subtransmission losses but not transmission substation losses, the combined cumulative loss factor at the subtransmission level is:

Combined cumulative loss factor = $f_1 * [(1+x_1) (1+x_2) - 1] + f_2 * x_2$

where

f_1 represents the fraction of energy arriving at subtransmission level via the conventional energy path,

and

f_2 represents the fraction of energy arriving at subtransmission from embedded generation. Other more complicated situations are possible.

3 OneSteel

3.1 Overview

OneSteel has submitted to the Tribunal proposed DLFs for its customers Delta EMD and Donhad Pty Ltd. These customers are connected to OneSteel's distribution network, located at Mayfield, Newcastle, at the 33kV and 11kV voltage levels respectively. The proposed DLF for Delta EMD is an update to its existing DLF which was last reviewed in 2001. Donhad Pty Ltd has recently moved to full contested status and must have a DLF calculated for it and approved by the Tribunal.

OneSteel wishes to apply the proposed DLFs in financial year 2007/08.

The DLF calculation methodologies applied, their outcomes, and IES' recommendations are discussed in the following sections.

3.2 Proposal

The Tribunal has provided to IES OneSteel's letter and attachments[1] outlining its proposed DLFs, showing sample calculations, and tabling the final values used in the calculation of its proposed DLFs.

OneSteel also submitted to IES two spreadsheets showing the calculation of its DLFs for the Delta EMD (NMI 7102000007) and the Donhad Pty Ltd (NMI 7102000008) sites. IES further communicated with OneSteel personnel to confirm the source and calculation of data inputs, and to discuss and clarify the methodologies and formulas applied.

Table 2 shows the customer name, National Meter Identifier (NMI), and proposed DLF for 2007/08.

Table 2: OneSteel's Proposed 2007/08 DLFs

Customer Name	NMI	Proposed DLF for 2007/08
Delta EMD	7102000007	1.00577
Donhad Pty Ltd	7102000008	1.01148

3.3 DLF Calculation Methodology

3.3.1 Overview

OneSteel's customers, Delta EMD and Donhad Pty Ltd, are connected to the 33kV and 11kV voltage levels, respectively, in OneSteel's distribution network.

[1] Letter titled "OneSteel Limited Exempt Network – Application for approval of Distribution Loss Factors on OneSteel's Mayfield Site", dated 20 August 2007.

As such, each requires a different methodology to calculate the losses attributable to the customer. These are described in the following sections.

3.3.2 Delta EMD Methodology

At the 33kV voltage level, Delta EMD losses include both the series (copper) and shunt (iron) losses attributable to its load in that part of the network.

The shunt losses are associated with the 'energy leakage' from two transformers in parallel. The total no load losses are calculated for these two transformers and losses are attributed to Delta EMD in proportion to its load compared to the total system load (approximately 25%).

The series losses are calculated from first principles and are proportional to the square of the power flow. OneSteel has provided a sample calculation of the no load losses (shunt) and series losses for Delta EMD in its letter to the Tribunal. IES confirms that the formulas applied are correct, and OneSteel confirms that this procedure was followed and applied on a monthly basis for financial year 2006/07.

The Delta EMD's monthly losses and load are summed for financial year 2006/07. Its DLF is then calculated as:

$$DLF = 1 + (losses \ / \ load)$$

The following table shows the results of the procedure carried out by OneSteel. The DLF for Delta EMD, based on historical data for financial year 2006/07 and to apply in financial year 2007/08, is estimated to be 1.00577.

Table 3 Delta EMD DLF Calculation

Date	Load (MWh)	Losses (MWh)	LF	DLF
Jul-06	5,837.50	31.12	0.005331	1.005331
Aug-06	6,230.05	32.91	0.005282	1.005282
Sep-06	4,767.40	26.31	0.005518	1.005518
Oct-06	6,175.05	33.20	0.005376	1.005376
Nov-06	6,022.84	33.78	0.005609	1.005609
Dec-06	5,650.67	36.23	0.006411	1.006411
Jan-07	4,583.90	29.71	0.006481	1.006481
Feb-07	3,968.85	22.72	0.005724	1.005724
Mar-07	4,489.18	26.63	0.005932	1.005932
Apr-07	4,203.16	27.50	0.006542	1.006542
May-07	4,658.85	25.97	0.005575	1.005575
Jun-07	4,620.22	27.54	0.005962	1.005962
2006/07	**61,207.67**	**353.35**	**0.005774**	**1.005774**

3.3.3 Donhad Pty Ltd Methodology

The proposed DLF for Donhad Pty Ltd is calculated using the energy supplied to OneSteel's distribution network and metered at its customer connection points, net of that for Delta EMD.

The net energy supplied and net customer load is calculated for each month in financial year 2006/07. The monthly figures are summed, and the DLF for OneSteel's other customers, including Donhad Pty Ltd, is calculated as:

$$DLF = energy\ supplied\ /\ load$$

Note that the formula above is equivalent to the formula given in Section 3.3.2 for Delta EMD.

Table 4 shows the results of the procedure carried out by OneSteel. The DLF for Donhad Pty Ltd, based on historical data for financial year 2006/07 and to apply in financial year 2007/08, is estimated to be 1.01148.

Table 4 Donhad Pty Ltd DLF Calculation

Date	Energy Supplied (MWh)	Customer Load (MWh)	DLF
Jul-06	16,014.68	15,840.06	1.01102
Aug-06	15,959.16	16,049.39	0.99438
Sep-06	15,369.59	15,149.91	1.01450
Oct-06	15,576.05	15,231.33	1.02263
Nov-06	14,092.81	14,034.99	1.00412
Dec-06	12,232.90	11,966.20	1.02229
Jan-07	12,908.07	12,673.28	1.01853
Feb-07	14,002.74	13,922.45	1.00577
Mar-07	14,692.48	14,614.26	1.00535
Apr-07	12,514.20	12,325.22	1.01533
May-07	15,868.75	15,604.36	1.01694
Jun-07	13,907.09	13,762.25	1.01052
2006/07	**173,138.52**	**171,173.69**	**1.01148**

3.4 Recommendations

With regards to the DLF calculation procedure, Section 3.6.3(h)(5) of the Rules states the following:

"In determining the *average electrical energy losses* referred to in clauses 3.6.3(h)(3) and (4), the *Distribution Network Service Provider* must use the most recent actual *load* and *generation* data available for a consecutive 12 month period but may adjust this *load* and *generation* data to take into account projected *load* and / or *generation* growth in the *financial year* in which the *distribution loss factors* are to apply."

IES confirms that the methodology applied by OneSteel calculates the average losses and uses the most recent historical data for a 12 month period, that is, financial year 2006/07.

IES examined the methodology applied by OneSteel in calculating its DLFs and considers it to be in accordance with the Rules and the Tribunal's approved methodology, as detailed in its document "Assessment and Approval Process of Distribution Loss Factors proposed by DNSPs".

Given that the input values provided in OneSteel's supporting spreadsheets are correct, the calculation methodologies have been applied correctly in determining DLF values.

OneSteel wishes to apply its proposed DLFs retrospectively, that is, from 1 April 2007 when OneSteel assumed responsibility for the supply of electricity within its distribution network. Given that the network has not undergone any major upgrades or changes to its structure since then, IES considers the proposed DLFs to be a reasonable estimate of losses as of 1 April 2007.

IES recommends that OneSteel's proposed DLFs for its customers Delta EMD and Donhad Pty Ltd are accepted as is and applied in financial year 2007/08, and retrospectively from 1 April 2007.

In future years it would be worthwhile for OneSteel to check that a DLF applied in a financial year (approximately) captures the actual losses for that year. That is:

$$net\ energy\ supplied \cong DLF * net\ customer\ load$$

for the historical financial year in which the DLF was applied. OneSteel should review its methodology where there is found to be a significant discrepancy between the actual losses and the losses implied by a customer's DLF.

Appendix A DLFs in the National Electricity Rules

DLFs are discussed in section *3.6.3* of the National Electricity Rules. Some important points stated in the Rules and taken into consideration, amongst other things, when assessing the correctness of the proposed DLFs are:

- calculation of an average distribution loss factor for energy losses for electricity transmitted between a distribution network connection point and a transmission network connection point or virtual transmission node;
- site specific DLFs for embedded generators with maximum generation above 10MW, and for customers with loads of more than 40GWh or demand of more than 10MW (for a consecutive 12 month period, if available, or based on projected generation and load);
- differentiation of customer type, such as by locational or geographical means;
- reconciliation of the previous financial year's energy sales and purchase data using the DLFs applying in that year.
- use of the most recent actual load and generation data available for a consecutive 12-month period, or adjusting the load and generation data to get projected values for the financial year in which the DLFs will apply.

The following extract from the National Electricity Rules describes the calculation of distribution loss factors. For completeness, clause 6.13.2, which is referred to in Section 3.6.3, and 3.15.4 are included.

3.6.3 Distribution Losses

(a) *Distribution losses* are *electrical energy losses* incurred in the conveyance of electricity over a *distribution network*.

(b) *Distribution loss factors*:

(1) notionally describe the *average electrical energy losses* for electricity transmitted on a *distribution network* between a *distribution network connection point* and a *transmission network connection point* or *virtual transmission node* for the financial year in which they apply;

(2) will be either:

(i) a site specific *distribution loss factor* derived in accordance with the methodology determined by the *Jurisdictional Regulator* or the *Distribution Network Service Provider* pursuant to clause 3.6.3(h), for each *distribution network connection point* of the following types:

(A) a *connection point* for an *embedded generating unit* with

actual *generation* of more than 10MW, based on the most recent data available for a consecutive 12 month period at the time of determining the *distribution loss factor*. Where relevant data is not available for a consecutive 12 month period as a *distribution network connection point* is newly established or has been modified, a *Network Service Provider* may determine whether an *embedded generating unit* has *generation* of more than 10MW, based on its best projection of *generation* in the *financial year* in which the *distribution loss factor* is to apply, taking into account the terms of the relevant *connection agreement*;

(B) a *connection point* for an end-user with actual or forecast *load* of more than 40GWh or an electrical demand of more than 10MW, based on the most recent data available for a consecutive 12 month period at the time of determining the *distribution loss factor*. Where relevant data is not available for a consecutive 12 month period as a *distribution network connection point* is newly established or has been modified, a *Network Service Provider* may determine whether an end user has *load* of more than 40GWh or forecast *peak load* of more than 10MW, based on its best projection of *load* in the *financial year* in which the *distribution loss factor* is to apply, taking into account the terms of the relevant *connection agreement*;

(C) a *connection point* for a *market network service provider*; and

(D) a *connection point* between two or more *distribution networks*; or

(ii) derived, in accordance with the methodology determined by the *Jurisdictional Regulator* or the *Distribution Network Service Provider* pursuant to clause 3.6.3(h), using the volume weighted average of the *average electrical energy loss* between the *transmission network connection point* or *virtual transmission node* to which it is assigned and each *distribution network connection point* in the relevant *voltage* class (determined in accordance with clause 3.6.3(d)(2)) assigned to that *transmission network connection point* or *virtual transmission node*, for all *connection points* on a *distribution network* not of a type described in clause 3.6.3(b)(2)(i);

(3) are to be used in the settlement process as a notional adjustment to the electrical *energy*, expressed in MWh, flowing at a *distribution network*

connection point in a *trading interval* to determine the *adjusted gross energy* amount for that *connection point* in that *trading interval*, in accordance with clause 3.15.4.

(b1) Where a *Generator* meets the reasonable cost of the *Distribution Network Service Provider* in performing the necessary calculation in respect of a *generating unit* of up to 10MW or 40GWh per annum capacity, the *Distribution Network Service Provider* must calculate a site specific *distribution loss factor* that, notwithstanding any other provision of the *Rules* to the contrary, for the purposes of the *Rules* is to apply in respect of that *generating unit* on the same basis as applies for a *generating unit* of more than 10MW or 40GWh per annum capacity as though the *generating unit* were a unit of more than 10MW or 40GWh per annum capacity.

(c) Each *Distribution Network Service Provider* must assign each *connection point* on its *distribution network*, of a type described in clause 3.6.3(b)(2)(i), to a single *transmission network connection point* taking into account normal *network* configurations and predominant *load* flows.

(a1) **[Deleted]**

(d) Each *Distribution Network Service Provider* must assign each *connection point* on its distribution network, not of a type described in clause 3.6.3(b)(2)(i):

(1) where practicable, to a single *transmission network connection point* or otherwise, to a *virtual transmission node*, taking into account normal network configurations and predominant *load* flows; and

(2) to a class of *distribution network connection points* based on the location of, *voltage* of and pattern of electrical *energy* flows at the *distribution network connection point*.

(e) So far as practicable, the assignment of *connection points* on the *distribution network* to:

(1) *transmission network connection points* under clause 3.6.3(c); or

(2) *transmission network connection points* or *virtual transmission nodes* and a class of *distribution network connection points* under clause 3.6.3(d), must be consistent with the geographic boundaries of the *pricing zones* determined in accordance with clause 6.13.2 for use in *distribution service* pricing, and the *voltage* levels incorporated within those *pricing zones*.

(f) The assignment of *connection points* on a distribution network:

(1) to a single *transmission network connection point* under clause 3.6.3(c); or

(2) to a *transmission network connection point* or *virtual transmission node* and a class of *distribution network connection points* under clause 3.6.3(d), is subject to the approval of the relevant *Jurisdictional Regulator* and the

Distribution Network Service Provider must inform *NEMMCO* of such approved assignments.

(g) *Distribution loss factors* must be determined by a *Distribution Network Service Provider* for all *connection points* on its *distribution network* either

individually, for all connection points assigned to a single *transmission network connection point* under clause 3.6.3(c), or collectively, for all *connection points* assigned to a *transmission network connection point* or a *virtual transmission node* and a particular *distribution network connection point* class under clause 3.6.3(d), in accordance with:

(1) the methodology developed, *published* and maintained by the *Jurisdictional Regulator* for the determination of *distribution loss factors*; or

(2) where the *Jurisdictional Regulator* has not *published* a methodology under clause 3.6.3(g)(1), the methodology developed, *published* and maintained by the *Distribution Network Service Provider* for the determination of *distribution loss factors*.

(h) The methodology for the determination of *distribution loss factors* referred to in clause 3.6.3(g) must be developed having regard to the following principles:

(1) The aggregate of the *adjusted gross energy* amounts for a *distribution network*, determined in accordance with clause 3.15.4 using the *distribution loss factors* for the *financial year* in which the *distribution loss factors* are to apply should equal, as closely as is reasonably practicable, the sum of:

A. the amount of electrical *energy*, expressed in MWh, flowing at all *connection points* in the *distribution network* in the *financial year* in which the *distribution loss factors* are to apply; and

B. the total *electrical energy losses* incurred on the *distribution network* in the *financial year* in which the *distribution loss factors* are to apply.

(2) The methodology used to determine *distribution loss factors* for a *financial year* should incorporate provisions requiring a *Distribution Network Service Provider* to undertake a reconciliation between the aggregate of the *adjusted gross energy* amounts for its *distribution network* for the previous *financial year* determined in accordance with clause 3.15.4 using the *distribution loss factors* that applied for *connection points* in that *distribution network* in the previous *financial year* and the sum of:

(i) the amount of electrical *energy*, expressed in MWh flowing, at all *connection points* in its *distribution network* in the previous *financial year*; and

(ii) the total *electrical energy losses* incurred on its *distribution network* in the previous *financial year*.

(3) The *distribution loss factor* for a *distribution network connection point*, other than those described in clause 3.6.3(b)(2)(i), is determined using a volume weighted average of the *average electrical energy loss* between the *transmission network connection point* or *virtual transmission node* to which it is assigned and each *distribution network connection point* in the relevant class of *distribution network connection points* assigned to that *transmission network connection point* or *virtual transmission node* for the *financial year* in which the *distribution loss factor* is to apply.

(4) The *distribution loss factor* for a *distribution network connection point* described in clause 3.6.3(b)(2)(i) is determined using the *average electrical energy loss* between the *distribution network connection point* and the *transmission network connection point* to which it is assigned in the *financial year* in which the *distribution loss factor* is to apply.

(5) In determining the *average electrical energy losses* referred to in clauses 3.6.3(h)(3) and (4), the *Distribution Network Service Provider* must use the most recent actual *load* and *generation* data available for a consecutive 12 month period but may adjust this *load* and *generation* data to take into account projected *load* and / or *generation* growth in the *financial year* in which the *distribution loss factors* are to apply.

(6) In determining *distribution loss factors*, flows in *network elements* that solely or principally provide *market network services* will be treated as invariant, as the methodology is not seeking to calculate the *marginal losses* within such *network elements*.

(i) Each year the *Distribution Network Service Provider* must determine the

distribution loss factors to apply in the next *financial year* in accordance with clause 3.6.3(g) and provide these to *NEMMCO* for *publication* by 1 April. Before providing the *distribution loss factors* to *NEMMCO* for *publication*, the *Distribution Network Service Provider* must obtain the approval of the relevant *Jurisdictional Regulator* for the *distribution loss factors* it has determined for the next *financial year*.

3.15.4 Adjusted energy amounts - connection points

Where a *connection point* is not a *transmission network connection point*, the *adjusted gross energy* amount for that *connection point* for a *trading interval* is calculated by the following formula:

$$AGE = ME \times DLF$$

where

AGE is the *adjusted gross energy* amount to be determined;

ME is the amount of electrical *energy*, expressed in MWh, flowing at the *connection point* in the *trading interval*, as recorded in the *metering data* in respect of that *connection point* and that *trading interval*, (expressed as a positive where the flow is towards the *transmission network connection point* to which the *connection point* is assigned, and negative where the flow is in the other direction); and

DLF is the *distribution loss factor* applicable at that *connection point.*

6.13.2 Allocation of aggregate annual revenue requirements to asset categories within classes of network service.

(a) The assets required by the *Distribution Network Service Provider* to deliver each class of *distribution service* except *common service* may be split into asset categories for the purpose of allocating the *aggregate annual revenue requirement* prior to setting prices.

(b) The asset categories referred to in clause 6.13.2(a) must be defined by the *Distribution Network Service Provider* and agreed with the *Jurisdictional Regulator* and may include:

(1) *use of system voltage* levels; and

(2) *connection asset voltage* levels.

(c) The *Distribution Network Service Provider* may elect to use locational prices and if used, the *Distribution Network Service Provider* must obtain the approval of the *Jurisdictional Regulator* and specify the locations and *voltage* levels for which these locational prices are to apply.

(d) The *Distribution Network Service Provider* may elect to divide its *network* into geographical areas for one or more *voltage* levels which will represent different zones for pricing purposes and if this occurs, the *Distribution Network Service Provider* must obtain the approval of the *Jurisdictional Regulator* to the geographic boundaries incorporated in the *pricing zones* and of the *voltage* levels of *distribution service* incorporated within these *pricing zones*.