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NETWORK SERVICE PROVIDER

DISTRIBUTION LOSS FACTOR

ANGLO COAL

MORANBAH NORTH COAL NSP

AUSTRALIAN ENERGY REGULATOR

FINANCIAL YEAR 2012-13

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1. SUMMARY

The terms of Hill Michael's engagement with Moranbah North Coal Network Service Provider (MNCNSP) include calculation of distribution loss factors in accordance with Section 3.6.3 (i) of the National Electricity Rules (NER). An extract of the relevant clause from the current version (Version 47) of the NER is given below:

"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 AEMO for publication by 1 April. Before providing the distribution loss factors to AEMO for publication, the Distribution Network Service Provider must obtain the approval of the AER for the distribution loss factors it has determined for the next financial year."

Hill Michael has calculated the distribution loss factors based on the forecast generation and mine load for the financial 2012-13. The embedded generation is dependent on the mine for fuel (coal seam methane gas), therefore, changes to the production level of the mine will impact the generation output.

The site specific DLF calculated using a Marginal Loss Factor (MLF) approach is **0.9969** for the EDL embedded generation connected to the **Moranbah North Coal Mine NSP**. This distribution loss factor has been calculated in accordance with the methodology approved by the QCA as described in **Report NCM 17699 Determination of Distribution Loss Factors for Embedded/Local Generators**.

In addition to the NER obligations, as required by the Australian Energy Regulator, this report has been provided to IES (Intelligent Energy Systems) for independent positive certification. Additional supporting evidence has been provided to IES to enable independent verification of calculations.

2. METHODOLOGY AND CALCULATIONS

2.1 METERED DATA - GENERATION AND CONNECTION POINT

The reconciled metered data for the parent meter and the revenue meter at the generator (National Metering Identifiers are given below) have been obtained from the authorised Metering Provider.

Parent NMI	QDDD000005
TNI / MDA	MRN / Ergon Energy
Generator NMI	7102000038

Below is the summary of the data based on the most recent half hourly metered data available for a consecutive 12 month period at the time of determining loss factors. The mine load is estimated based on the difference between the connection point and the generation metered data.

- Connection Point (MWh): This is the total energy from connection point meter.

  Net negative energy indicates that the energy provided by generation is higher than the energy consumed by the load for that month. The converse is true for Net positive energy.

- Generation (MWh): This is the monthly energy output of the generator measured at the generator revenue meter.

  Net negative energy indicates the energy provided by the generators to the system

- Estimated Mine Load (MW): Difference of Connection Point (MWh) and Generation (MWh) converted to MW. The conversion between MWh to MW is calculated based on 24 hours a day operation of the mine.

[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
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[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

Table 1: Metered Data for 2011

2.1.1 Generation and Load Projection for 2012/13

Generation Projection: EDL Power Station advises a [redacted] MW of installed capacity at unity power factor will be available in 2012/13. This availability takes into account contingencies and planned outages.

Mine Load Projection: 2012/13 Mine load forecast given by Moranbah North Coal is shown in Table 2. Moranbah North Coal advises;

[redacted]

[redacted]

2012/13 EDL generation and Moranbah North Coal mine forecasts are shown in Table 2 below.

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
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[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
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[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 2: Forecast Data for 2012-13

2.1.2 Network Connection Points

The Moranbah North Coal Mine Network Service Provider (MNCNSP) owns and operates the 66 kV distribution network which is connected to the Ergon Energy Corporation Limited (EECL) Moranbah substation.

The embedded generation owned and operated by EDL will be the only customer on the MNCNSP network; subsequently MNCNSP will have only one distribution network connection point. The mine is a customer of EECL and the mine distribution network connection point is located at the Moranbah 66 kV busbar. The mine connection point is also the MNCNSP connection point to the EECL network service. The EDL embedded generator distribution network connection point is on the MNCNSP 66 kV network.

Figure 1 below shows the location of the connection points and the network for which losses are calculated.

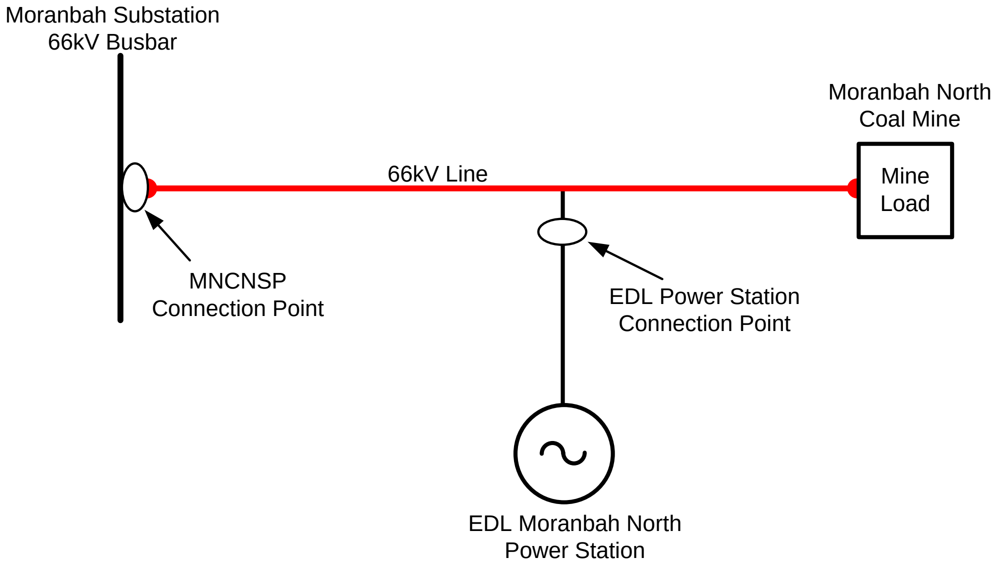

Figure 1: Simplified Representation of the Network

2.1.3 Methodology

EDL Generator DLF Calculation

MNCNSP has one connection point on its distribution network and the site specific DLF for this connection point has been calculated in accordance with the methodology approved by the Queensland Competition Authority (QCA) as described in **Report NCM 17699 Determination of Distribution Loss Factors for Embedded/Local Generators**. (Refer APPENDIX 2 – REPORT NCM17699)

The DLF is a static loss factor which is applied to the embedded generator distribution network connection point for the full financial year. The steps undertaken to calculate the DLF are summarised below.

1. Request expected mine consumption and embedded generation forecasts for the 2012-13 financial year.

2. Prepare and review the network model for the MNCNSP distribution network by incorporating any proposed changes to the network occurring in the period leading up to the financial year for which the embedded generator DLF is being calculated.

   The PSS/SINCAL network model (given in Figure 2) represents the following:

   a. Moranbah (MRN) 66 kV connection point as an infinite bus;

   b. Moranbah North Mine load at the 66 kV busbar at the Mine Boundary Substation;

   c. EDL Generation Tee off to MNCNSP at the generator connection point.

3. Using the Network Model and Load Flow Analysis, the following steps are performed.

- Note the loss on the NSP network for initial generation (A). The NSP network is between the 66kV MNCNSP connection point at Moranbah Substation and Moranbah North Coal Mine connection point.
- Increment the generation by 1 MW and note the new loss on the NSP Network (B).
- Run a set of load flow studies for each month of the next financial year using the forecast mine load and embedded generation data.
- The loss due to the increment in generation per MW is calculated (B-A)/1000.

4. Calculate the MLF and DLF in accordance with the methodology approved by the QCA as described in **Report NCM 17699**.

2.1.4 Distribution Loss Factor

The loss under proposed generation on the NSP network is noted (A), then the generation is incremented by 1 MW and the new loss on the NSP network is observed (B). The difference in the loss after the 1 MW increment is (B-A)/1000 per MW. The marginal loss factor is 1 less the loss per MW of generation increment.

The volume weighted DLF is weighted on the average forecast generation per month**.**

DLF calculation results for the forecast generation and mine load data for the year 2012/13 given in Table 3.

Period	Generation (MW)	Mine Load (MW)	A (kW) NSP Loss	B (kW) NSP Loss for Increment in Generation	MLF [1 - (B-A)/1000]	DLF [SQRT (MLF)]
Jul-12	[redacted]	[redacted]	[redacted]	[redacted]	0.9896	0.9948
Aug-12	[redacted]	[redacted]	[redacted]	[redacted]	0.9846	0.9923
Sep-12	[redacted]	[redacted]	[redacted]	[redacted]	0.9896	0.9948
Oct-12	[redacted]	[redacted]	[redacted]	[redacted]	0.9896	0.9948
Nov-12	[redacted]	[redacted]	[redacted]	[redacted]	0.9941	0.9970
Dec-12	[redacted]	[redacted]	[redacted]	[redacted]	0.9955	0.9978
Jan-13	[redacted]	[redacted]	[redacted]	[redacted]	0.9955	0.9978
Feb-13	[redacted]	[redacted]	[redacted]	[redacted]	0.9976	0.9988
Mar-13	[redacted]	[redacted]	[redacted]	[redacted]	0.9976	0.9988
Apr-13	[redacted]	[redacted]	[redacted]	[redacted]	0.9976	0.9988
May-13	[redacted]	[redacted]	[redacted]	[redacted]	0.9976	0.9988
Jun-13	[redacted]	[redacted]	[redacted]	[redacted]	0.9976	0.9988
	Volume weighted average DLF with forecast generation and mine load data					**0.9969**

Table 3: Volume Weighted Average DLF

3. APPENDIX 1 – SCHEMATIC OF MORANBAH NORTH COAL NSP

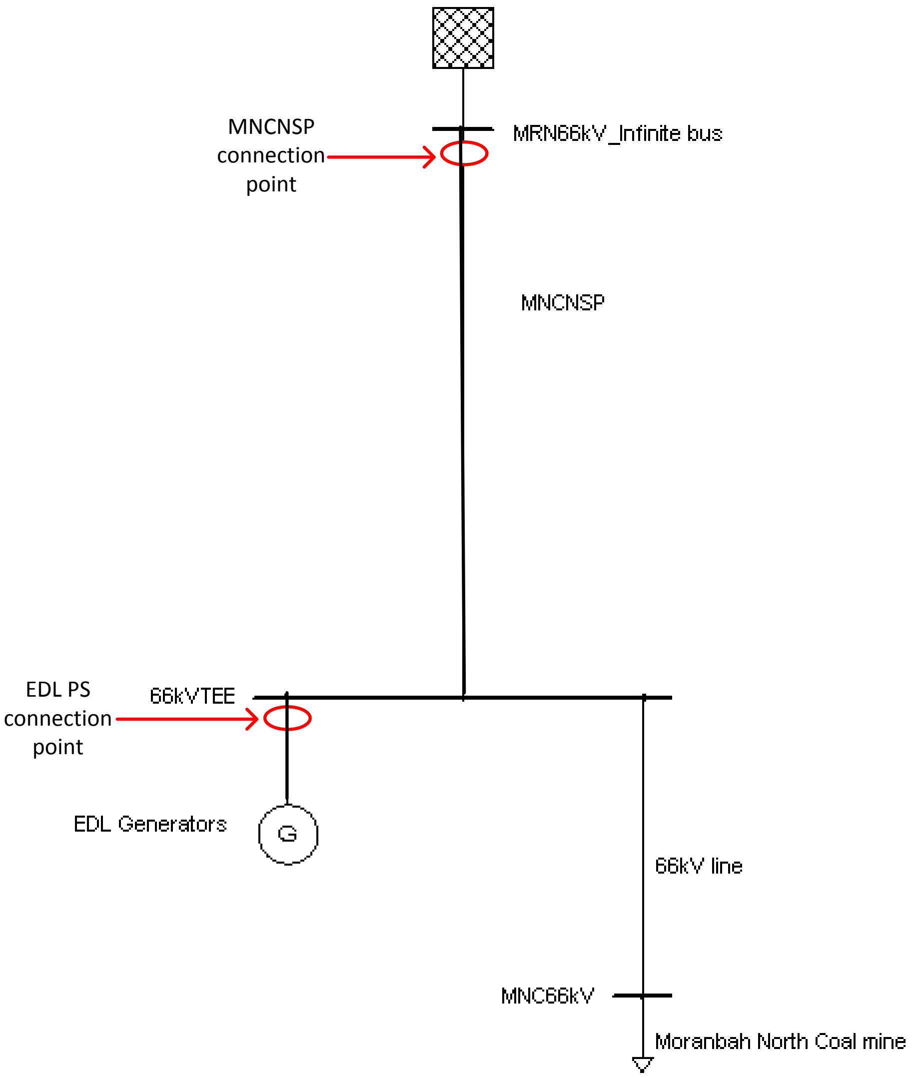

Figure 2: Moranbah North Coal NSP Network as modelled in PSS/SINCAL

4. APPENDIX 2 – REPORT NCM17699

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DETERMINATION OF DISTRIBUTION LOSS FACTORS FOR EMBEDDED/LOCAL GENERATORS

REPORT NCM17699

1.0 Introduction

Section 3.6.3 of the National Electricity Code describes the requirement for Distribution Loss Factors for Market Generators (or market generating units). The NEC goes on to describe the Distribution Loss Factor for a market generating unit as:

> "a site specific factor that describes the volume weighted average electricity loss incurred in the *distribution* of electricity between a *transmission network connection point* and the relevant *Generator's connection point* for a defined period of time and associated operating conditions."

This Code clause indicates that non-scheduled market generators are to be allocated an average rather than a half hourly marginal distribution loss factor. This interpretation is consistent with previous decisions of the Jurisdictional Regulator in relation to distribution loss factors for generators not directly connected to the transmission network.

This paper sets out the process that ENERGEX Limited and Ergon Energy Corporation Limited ("the Distributors") propose to use for calculating DLF's for those NEMMCO registered embedded generators who are not selling their entire energy output to the local retailer and therefore require a DLF.

2.0 Calculation Methodology

The procedure developed by the Distributors for calculation of DLF's for distribution network connected market generators is:

Step 1

The appropriate part of the subtransmission network should be modelled by including all directly connected 132kV, 66kV, 33kV, 22kV, and 11kV customers along with direct connected loads representative of the 22kV and 11kV feeders (lumped at the 22kV and 11kV buses and/or distributed along the feeder on which the embedded generator is connected). The Embedded Generators should be modelled at their metering points. The Transmission Network Connection Point may be modelled as an infinite bus.

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DETERMINATION OF DISTRIBUTION LOSS FACTORS FOR EMBEDDED/LOCAL GENERATORS

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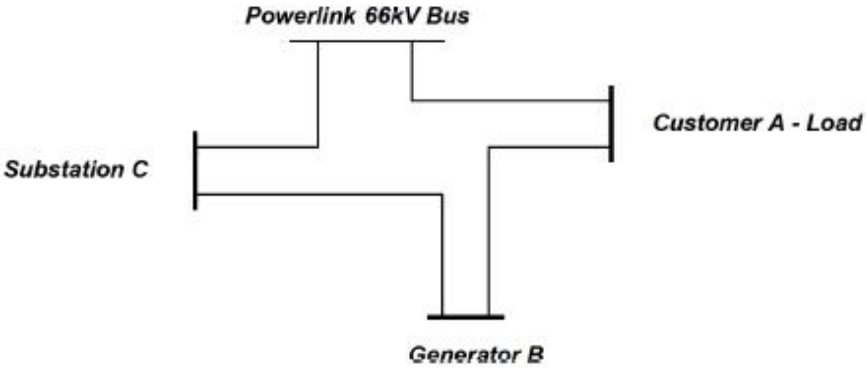
A set of generator operating states is developed relative to the network load and generation patterns with a state for each reasonable distinguishable discrete generator/load condition. Each state will be defined by a time period, a constant average load and a constant average generator output. The load and generation are the averages during the time period of the operating state being studied. The operating states combined must occupy the full time frame associated with the required DLF. This will normally be one year.

A table of operating states with time periods, average loads and average generator outputs should be developed

An example network is described below:



Customer A has a single shift operation and a load of 10MW between 0700 and 1700.

Generator B has an output of 15MW over the period 0600 to 2100. The generator output and operating periods for the full year are to be specified by the Financially Responsible market Participant. Only one average DLF will be calculated for the year.

Substation C is a domestic type load which can be characterised by 0700 to 1800 – 5MW, 1800 to 2100 – 8MW and 2100 to 0700 - 2MW

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The resultant discrete operating states table would be :

State	*Duration*	*Load A*	*Gen B*	*Sub C*
1	0700 – 1700	10MW	15MW	5MW
2	1700 – 1800	0	15MW	5MW
3	1800 – 2100	0	15MW	8MW
4	2100 – 0600	0	0	2MW
5	0600 – 0700	0	15MW	2MW

State 4 does not need to be modelled as the Generator is not operating during that period.

As an alternative the operating states table may be developed from a load duration curve when sufficient data exists and the generator output is reasonably constant

Step 2

A load flow study is run for each of the relevant operating states with the average load and average generation in that state.

The output from the embedded generator is incremented and the load flow studies are repeated for each of the relevant operating states with the same average loads

The net increase in system demand (generation output plus Transmission Network Connection Point load) for each operating state is recorded.

The Marginal Loss Factor for that generator in that operating state is calculated by dividing the net system demand (generator output plus load at the Transmission Network Connection Point) increase by the increase in generation and subtracting the result from 1. [There has been no change in load so that the net system demand change is a loss change

DETERMINATION OF DISTRIBUTION LOSS FACTORS FOR EMBEDDED/LOCAL GENERATORS

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due to sourcing the increment from the generator instead of from the Transmission Network Connection Point].
MLF = 1 - (System Demand Increase/Generator Output Increase)

Step 3

Convert the set of Marginal Loss Factors to an equivalent set of Distribution Loss Factors by taking the square root of the MLF.
Note:

- *Distribution Loss Factor (average)= SQRT(MLF X LF)*
- *As we are using constant average loads to model for each operating state, the Load Factor (LF) = 1 for that state*
- *Thus in this model DLF (average) = SQRT(MLF)*

An operating states table is then built with MLF, DLF' and the energy exported by the Generator during that operating state.

The table developed for our example is:

State	*MLF*	*DLF*	*Energy Exported*
1	1.04	1.02	150 MWh
2	0.96	0.98	15 MWh
3	0.98	0.99	45 MWh
5	0.88	0.94	15 MWh

Step 4

The annual volume weighted distribution loss factor for each generator is calculated from the tabulated DLF's and generation energy exported for each of the discrete operating states .

For example, in our test network the DLF would be

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DETERMINATION OF DISTRIBUTION LOSS FACTORS FOR EMBEDDED/LOCAL GENERATORS

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$$DLF = \frac{1.02 * 150\ MWh + 0.98 * 15MWh + 0.99 * 45\ MWh + 0.94 * 15MWh}{(150 + 15 + 45 + 15)\ MWh}$$

$$= 1.006$$

Step 5 - Two or more generators in the network

Steps 1 to 4 are undertaken to calculate the DLF for each generator separately The DLF for any generator is calculated by incrementing only that generator's output and running all the load flow studies with the average generation from each of the other generators.

3.0 Reality Check

A generator which is reducing losses in the system will have a DLF greater than unity. That is, the losses in the network are reduced by taking incremental supply from the generator rather than from the Transmission Network Connection Point and therefore more capacity is saved at the Transmission Network Connection Point than was added by the generator. A DLF greater than unity will result in the generation energy adjusted to the Transmission Network Connection Point being greater than the metered generator energy output

A generator which increases losses will have a DLF below unity.

These DLF's for embedded generators are consistent with the TLF's applied to transmission grid connected generators. That is if the generator adds to the total amount of losses in the system, then the DLF or TLF will be less that unity. If the generator reduces the losses in the system, the DLF or TLF will be greater than unity.

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