# METHODOLOGY FOR CALCULATING FORWARD-LOOKING TRANSMISSION LOSS FACTORS: FINAL METHODOLOGYMETHODOLOGY FOR CALCULATING FORWARD LOOKING TRANSMISSION LOSS FACTORS

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FINALDRAFT

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# Version Release History

| VERSION | DATE | BY | CHANGES |
|---|---|---|---|
| 5.0 | 18 September 2014 | SP&C | Updates to Methodology to include changes resulting from the Draft Determination of the 2014 Rules Consultation. |
| 4.0 | 29 June 2011 | ESOPP | Updates to methodology for calculating dual marginal loss factors for a transmission network connection point. |
| 3.0 | 1 April 2010 | ESOPP | Methodology for Calculating Forward-Looking Loss Factors: Final Methodology updated to include changes resulting from the more recent Rules Consultation completed on 27 February 2009. |
| 2.0 | 12 August 2003 | Planning | Methodology for Calculating Forward-Looking Loss Factors: Final Methodology updated. |
| 1.0 | 7 May 2003 | Planning | Methodology for Calculating Forward-Looking Loss Factors: Final Methodology developed after extensive consultation was conducted during 2002 and 2003. |

# 1 Purpose of this document

This document specifies how AEMO calculates Forward Looking Loss Factors (FLLF), also known as Marginal Loss Factors1 (MLFs). The National Electricity Rules (NER) requires AEMO to calculate and publish MLFs annually.

# 2 Backgound

The NER requires AEMO each year to annually calculate MLFs - also know as intra-regional loss factors – and inter regional loss factor equations, and publish the results by April 1. The RulesNER requires AEMO to calculate and publish a single, volume weighted average, intra-regional MLF for each connection point[2].

In a power system electrical losses are function the load, networks and generation mix which is constantly changing. Also, a feature of electrical losses is that they increase exponentiallyquadratically in proportion to the electrical power transmitted (Losses ∝α Current$^2$). These variables mean that a single MLF for each connection point is necessarily an approximation.

## 2.1 Electrical Losses

Electrical transmission losses are a transport cost that needs to be priced and factored into electrical energy prices. MLFs s are factors that represent electrical losses (caused by the transport of electricity) between a connection point and a regional reference node (RRN). The factors are used to adjust electricity spot prices (set at the RRN) to reflect electrical losses between the RNN and a connection point.

## 2.2 Marginal Losses

The National Electricity Market (NEM) uses marginal costs as the basis for setting electricity prices in line with the economic principle of marginal pricing. There are three components to a marginal price in the NEM: energy, losses and congestion.

The marginal spot price for electrical energy is determined, or is set, by the incremental cost of additional generation (or demand reduction) for each spot market interval. Consistent with this, the marginal loss is the incremental increase in total losses for each incremental additional unit of electricity. The MLF of a connection point represents the marginal losses to deliver electricity to that connection point from the RRN.

# 3 Regulatory Requirements

Cclause 3.6 of the NERRules requires AEMO to calculate the MLFs and inter-regional loss factor equations by 1 April each year to apply for the next financial year.
Clauses 3.6.1, 3.6.2 and 3.6.2(A) specify the requirements for calculating the MLFs and inter-regional loss factor equations, and the data used in the calculation.

The Rules require AEMO to calculate and publish a single, volume weighted average, intra-regional MLF for each connection point. The Rules also require AEMO to calculate and publish dual MLFs for connection points where one MLF does not satisfactorily represent transmission network losses for active energy generation and consumption.

[1] Marginal Loss Factors are also known as Intra-regional Loss Factors

[2] The Rules also require AEMO to calculate and publish dual MLFs for connection points where one MLF does not satisfactorily represent transmission network losses for active energy generation and consumption.

# 4 Principles used by the Methodology

The following principles were used to establish this mMethodology.:

- Calculate factors that are forwarding looking
- Use a full year's data (rather than a representative sample); and
- Use minimal extrapolation of historical data
- Use best approximation to Full Nodal Pricing as a guide to comparing alternative approaches
- Calculate loss factors based on marginal losses (or the derivative of losses with respect to demand) at each connection point

Methodology for Calculating Forward-Looking Transmission Loss Factors: Final Methodology was developed after considering the issues raised in the Rules Consultation conducted between April 2002 and May 2003 as well as issues raised in the more recent Rules Consultation conducted in February 2009 [7].

By virtue of Clause 18(1)(a) of the National Electricity Regulations, a reference in the Methodology for Calculating Forward – Looking Transmission Loss Factors: Final Methodology, to any provision of the National Electricity Code, is taken to be a reference to the corresponding provision or provisions in the National Electricity Rules.

Clause 18(1)(a) of the National Electricity Regulations provides as follows:

**18 Continuation of things done under Code**

(1) On the commencement date of the new National Electricity Law—

(a) each rule, principle, guideline, test, standard, procedure, report, protocol or other document (however described) that had been issued, published, made, promulgated, approved, accepted or prepared under, or for the purposes of, a provision of the Code and that was in force for the purposes of the Code, or continued to have some effect or contingent effect for the purposes of the Code, immediately before the commencement date is to be taken to have been issued, published, made, promulgated, approved, accepted or prepared under, or for the purposes of, the provision of the Rules (if any) that corresponds to that provision of the Code.

On 27 February 2009 NEMMCO completed Rules Consultation [7] to address the following material issues:

- Accounting for abnormal conditions affecting NEM generation patterns; and
- Proposed method to deal with pump storage schemes.

NEMMCO's response to the issues was as follows:

- Where a generator's historical pattern has been affected due to unforeseen circumstances, i.e. circumstances not physically controllable, NEMMCO will allow generator proponents to provide an adjusted profile for the generator affected. NEMMCO then has the discretion to accept or reject the adjustment on the basis that the justification given is sufficient and reasonable; and
- Where a pump storage facility's net energy balance between the energy absorption and energy generation is less than 30% of the energy generation, NEMMCO will calculate a single time-weighted marginal loss factor for the connection point if it is not feasibly reasonable for that pump storage facility to have separate metering points and separate connection points for each direction of energy flow. Provided this is permitted by the Rules and is consistent in all other respects with this Methodology, NEMMCO may calculate more than one intra-regional loss factor for a connection point for a pump storage facility.

As an outcome of the final determination the following sections of the Methodology for Calculating Forward – Looking Transmission Loss Factors: Final Methodology are added or amended:

a) 5.4.1 Obtaining a list of committed new generators

b) 5.4.5 Retired generating units

c) 5.5.3 Generator capacities

d) 5.5.6 Accounting for abnormal conditions affecting NEM generation patterns

e) 5.6.1 Calculating intra-regional static loss factors for pump storage schemes

**Brief Background to Consultation Conducted During 2002 and 2003**

In March 2002 NECA submitted Stage 1 of the Review of the Integration of the Energy Market and Network Services (RIEMNS) package of Code changes to the ACCC for authorisation. This package includes the requirement for NEMMCO to consult on a forward-looking methodology for calculating loss factors for the transmission network. In particular:

- the methodology for determining the inter-regional loss factor equations (clause 3.6.2A(c));
- the methodology for determining intra-regional loss factors (clause 3.6.2A(e)); and
- the methodology for forecasting and modelling the load and generation data used to calculate the inter-regional loss factor equations and intra-regional loss factors (clause 3.6.2A(g))

The ACCC consulted on the RIEMNS Stage 1 Code change package. The ACCC has granted interim authorisation to Code changes that require NEMMCO to develop the forward-looking methodology but retain the backward-looking methodology. On 4 September 2002 the ACCC published their draft determination on the RIEMNS Stage 1 Code Changes. The draft determination did not impose any significant conditions on NEMMCO. The Code changes were gazetted on 7 November 2002 and will take effect from 1 January 2004.

NEMMCO prepared and published an Issues Paper [1] in April 2002. NEMMCO received 10 submissions during this consultation process. A Public Forum was held by NEMMCO in Sydney on 12 July 2002. NEMMCO considered the issues raised in the consultation and the public forum, and prepared a Draft Methodology [5] that was published for consultation on 2 October 2002. The consultation on the Draft Methodology closed on 18 October 2002 and NEMMCO received six submissions.

Therefore, the purpose of this document is to:

- describe the consultation process NEMMCO followed to fulfil the requirements of clauses 3.6.2A(c), 3.6.2A(e) and 3.6.2A(g) as proposed in the NECA drafting submitted to the ACCC;
- discuss the issues NEMMCO has considered in developing its loss factor methodology during the consultation in 2002 and more recently in 2009;
- address the issues raised in the consultation on the Draft Methodology [5]; as well as the outcomes of the final determination to the consultation conducted in February 2009 [7]
- describe the final methodology that NEMMCO is proposing.

# 2 Consultation Process conducted in 2002

As discussed above, clauses 3.6.2A(c), 3.6.2A(e) and 3.6.2A(g) of the RIEMNS Stage 1 Code change package require NEMMCO, in accordance with the Code consultation procedures, to develop, subsequently publish and maintain the methodology which is to apply to the calculation of transmission loss factors.

NEMMCO must perform the consultation in accordance with the Code consultation procedures in clause 8.9 of the Code.

Figure 2.1 illustrates the Code consultation process.

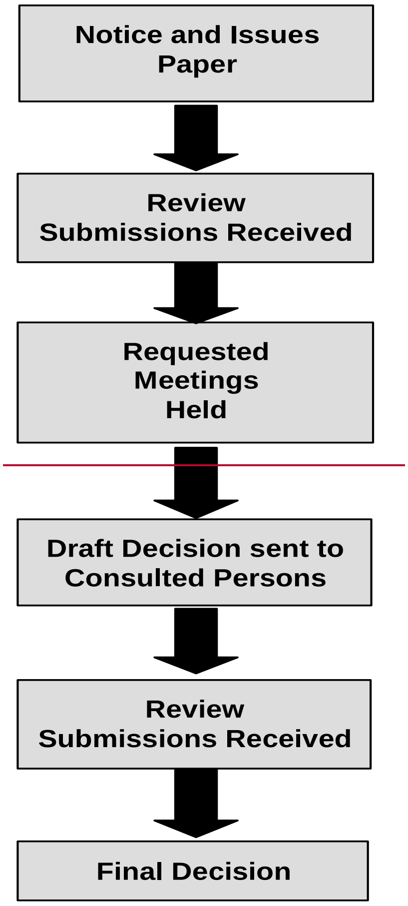


*Figure 2.1 Code Consultation Procedure defined in Clause 8.9*

## 2.1 Notice

NEMMCO announced that the consultation commenced on 24 April 2002. The associated notice was sent to all Code Participants, Intending Participants and interested parties.

NEMMCO invited submissions on the issues associated with the Code changes for the calculation of forward-looking transmission loss factors. In particular, NEMMCO sought comment on the proposed methodology for calculating the marginal loss equations and the static marginal loss factors for transmission connection points and the method used to establish the data sets used for these calculations.

Submission closed on 3 June 2002. This provided the consulted parties more than the 25 business days minimum requirement specified in clause 8.9(a).

NEMMCO received eights submissions by the due date and accepted two late submissions.

## 2.2 Review Submissions Received

Clause 8.9(f) requires that as the consulting party, NEMMCO must consider all valid submissions within a period of not more than a further 20 business days after the close of the consultation period.

On 28 June 2002 NEMMCO published a matrix of issues raised in the submissions. A detailed discussion of these issues is presented in Appendix A.

## 2.3 Meetings and Public Forum

NEMMCO held a Public Forum to discuss the methodology for calculating forward-looking transmission loss factors in Sydney on 12 July 2002. NEMMCO received no requests for individual meetings.

## 2.4 Draft Decision Sent to Consulted Parties

Following the consideration of all valid submissions and holding the public forum NEMMCO published a draft methodology.

NEMMCO invited submissions on this draft methodology for the calculation of forward-looking loss factors. To be valid, a submission must have been received before the closing date of 18 October 2002. This gave the consulted parties at least the 10 business days minimum specified in clause 8.9(i).

NEMMCO published submissions on the NEMMCO website and sent notices to the consulted parties.

## 2.5 Review Submissions

Clause 8.9(j) requires NEMMCO to consider all valid submissions within a period of not more than a further 30 business days.

## 2.6 Final Decision

NEMMCO is publishing its final report on their website following the consideration of all valid submissions. Clause 8.9(k) requires that the final report set out:

- NEMMCO's conclusions and any determinations on the matter under consultation;
- its reasons for those conclusions;
- the procedure followed by NEMMCO in considering the matter; and
- summaries of each issue that NEMMCO reasonably considers to be material and the response to each such issue.

## 2.7 Consultation on Final Methodology

NEMMCO published version V01 of their final Forward-looking Loss Factor methodology on 7 May 2003. NEMMCO allowed a two week period for further consultation on this version of the methodology. Submissions closed at 5:00pm on 26 May 2003.

NEMMCO received one submission from Yallourn Energy and this submission was published on the NEMMCO internet site. The issues raised in Yallourn Energy's submission are discussed in Appendix C of this document.

# 3 Background

## 3.1 Forward-looking Loss Factor Issues Paper

NEMMCO published a detailed background to the forward-looking loss factor consultation in Section 3 of their Issues Paper [1]. The section included:

- a discussion on locational pricing and how losses are treated in the NEM;
- an overview of the present methodology for calculating loss factors;
- a brief history of the review of the integration of the energy market and network Services (RIEMNS) process;
- a discussion on the requirement for NEMMCO to develop methodologies to calculate forward-looking inter-regional loss factor equations; and
- a report on the activities of the forward-looking loss factor reference group that was established by NEMMCO to assist in their preparation of the Issues Paper [1].

## 3.2 Interim Code changes

After NEMMCO published the Issues Paper [1] the ACCC granted interim authorisation to Code changes that require NEMMCO to develop the forward-looking methodology while retaining the backward-looking methodology. NECA gazetted these Code changes on 27 June 2002.

The NEMMCO consultation to develop the forward-looking loss factors is derived from clauses 3.6.1(c), 3.6.2(d) and 3.6.2A(b) of the RIEMNS Stage 1 Code changes. These clauses correspond to clauses 3.6.2A(c), 3.6.2A(e) and 3.6.2A(g) of the interim Code changes.

## 3.3 ACCC Draft Determination

The ACCC published their draft determination on the RIEMNS Stage 1 on 4 September 2002. The draft determination imposes the condition of authorisation that clause 3.6.2A(c) be amended as follows:

> The methodology developed and published by NEMMCO under clause 3.6.2A(b) must specify information reasonably required by NEMMCO to fulfil its obligations under clause 3.6.2A, including without limitation historic load and generation data, forecast energy and maximum demand data for a connection point and forecast data for any new loads. In particular, the methodology must specify information to be provided by Code Participants that is in addition to the information provided by those Code Participants under other provisions of the Code.

NEMMCO considers that this condition of authorisation does not materially change the issues being consulted on.

## 3.4 Gazettal of the RIEMNS Stage 1 Code Changes

The RIEMNS Stage 1 Code changes were gazetted on 7 November 2002 and will take effect from 1 January 2004. Therefore, NEMMCO continued to develop their Forward-looking Loss Factor Methodology.

# 4 Issues being considered by NEMMCO

This section discusses the issues NEMMCO considered when developing this draft forward-looking loss factor methodology.

## 4.1 Principles from the Methodology

Clauses 3.6.2A(d), 3.6.2A(f) and 3.6.2A(i) of the gazetted RIEMNS Stage 1 Code changes require NEMMCO to consider a number of principles when developing the forward-looking loss factor methodology. These principles are contained in clauses 3.6.2A(d), 3.6.2A(f) and 3.6.2A(i) of the interim Code changes gazetted on 27 June 2002. The same principles are presented in section 4.1 of the NEMMCO Issues Paper [1] and the Draft Methodology [5].

Section 4.1 of the Issues Paper [1] also includes some principles that were introduced by NEMMCO. These principles include:

- minimal extrapolation
- using the best approximation to Full Nodal Pricing as a guide to comparing alternative approaches;
- calculating the loss factor for each connection point based on the derivative of losses with respect to demand at that connection point;
- calculating the loss factors for a full year's data (rather than a representative sample); and
- balancing the supply and demand by making minimal changes to the historical generation data.

## 4.2 Transmission Network Model

Section 4.2 of the NEMMCO Issues Paper [1] discusses the aspects of the methodology that relate to the transmission network model used when calculating the forward-looking loss factors.

The following questions need to be considered.

### 4.2.1 How many network configurations are required?

At present NEMMCO calculates the transmission loss factors using a single network configuration based on the normal network configuration at high load conditions. Specifically, in Victoria, the power system will be modelled in radial mode[3] and the special arrangements applying to Yallourn Unit 1 will be represented. This is discussed more fully in section 4.2.1 of the NEMMCO Issues Paper [1] and in section 7.22 of Appendix A.

Section 4.2.2 of the Issues Paper discusses the option of dividing the financial year in which the loss factors apply into two components (July to October and November to June). This would allow different network configurations to be used – if required – to represent possible changes in the network configuration through the year. This option was proposed as it would provide a potential improvement in the accuracy.

The Powerlink submission was the only submission that supported dividing the year into two components and no other submissions addressed the issue.

NEMMCO considers that the advantages of using two different network representations for the two parts of the year may not be justified as:

3 Radial mode refers to operation of the 500kV and 220kV networks between Melbourne and the Latrobe Valley. The two networks can be operated either radially or in parallel, with radial mode used to reduce the severity of potential faults to within the capability of circuit breakers to interrupt the fault.

- only a relatively small number of additional augmentations would be included for the second portion of the financial year as the majority of network augmentations are commissioned in time for the summer and would be included for the entire financial year; and
- there would be added complexity in the calculation process because the current software package, TPRICE, is currently only able to consider a single network configuration.

Therefore, NEMMCO will initially use only a single network configuration in the methodology and would include any project that is committed to be commissioned prior in the financial year in which the loss factors are applied.

NEMMCO is investigating changes to their systems to permit more than one network model. When the NEMMCO systems have been modified to include multiple networks then NEMMCO proposes to then divide the year into the three portions, i.e. July to October, November to February and March to June. NEMMCO advises the market that when the capability is available it will be used for the next loss factor calculation and the market will be informed.

### 4.2.2 How are future network augmentations verified?

NEMMCO believes it is appropriate to incorporate only committed network options in the loss factor calculations.

NEMMCO will require the TNSPs to indicate that each included network project meets the commitment criterion in section 9.3 of the NEMMCO SOO [2] to ensure consistency across the different jurisdictions. At present the criteria in the SOO are:

1. the proponent has purchased/settled/acquired land[4] (or legal proceedings have commenced) for the construction of the proposed development;
2. contracts for the supply and construction of the major components of plant or equipment (such as generators, turbines, boilers, transmission towers, conductor, terminal station equipment) should be finalised and executed, including any provisions for cancellation payments;
3. the proponent has obtained all required planning consents, construction approvals and licences, including completion and acceptance of any necessary environmental impact statements;
4. the financing arrangements for the proposal, including any debt plans, must have been concluded and contracts executed; and
5. construction of the proposal must either have commenced or a firm commencement date must have been set.

If the commitment criteria in the SOO are modified in the future then NEMMCO will use the revised criteria in this methodology.

Considering that the loss factor calculations will only require network developments within the next 12-18 months, there should be little difficulty evaluating the criteria for commitment.

## 4.3 Forecast Connection Point Loads

The annual energy in the NEM may grow by several percent per year, and this will impact on transmission flows and the dispatch of generation throughout the interconnected power system. To include this effect in marginal loss factor calculations, historical load data should be scaled up

[4] Purchase of land or acquisition of easements, if required, do not imply by themselves a binding financial commitment but are a pre-requisite for commitment.

to the demand and energy levels expected for the financial year for which the marginal loss factors apply.

Clause 3.6.2A(d)(1) requires load data that is representative of the expected load in the financial year in which the loss factors and loss factor equations are to apply, having regard to the most recent actual data available and the projected load growth.

### 4.3.1 TNSPs to Provide NEMMCO with Connection Point Load Forecasts

NEMMCO and the TNSPs believe that the connection point load forecasts should be provided by the TNSPs based on the detailed information available to them, including that provided by the DNSPs. The provision of connection point loads by TNSPs was supported by the consultation on the NEMMCO Issues Paper [1].

If a TNSP is unable to supply NEMMCO with connection point load forecasts by trading interval for their respective jurisdiction then NEMMCO will generate the connection point forecasts. NEMMCO would use the simple push-pull algorithm described in Appendix A of the NEMMCO Issues Paper [1] to match the associated forecast in the latest SOO [2]. NEMMCO would consult with the associated TNSP to prevent scaling of known fixed loads such as smelters.

The accuracy of the loss factors will be enhanced if detailed connection point forecasts are provided and it is NEMMCO's clear preference that the TNSPs provide these forecasts. The option of NEMMCO scaling loads is considered an option of last resort.

### 4.3.2 Historical Connection Point Load Data

Section 4.3.1 of the NEMMCO Issues Paper [1] shows that the most recently available historical data that can readily be used to calculate forward-looking loss factors is the data from the previous financial year. This data, which is based on settlements data, is only finalised after 6 months have elapsed. This allows sufficient time for any disputes on the data to be identified.

Since the publication of their Issues Paper, NEMMCO has made further investigations with the TNSPs, as the entities that will supply NEMMCO with the forecast load traces. The TNSPs have advised that they will require several months to prepare the scaled connection point load data. Therefore, NEMMCO intends to use connection point load data from the most recent financial year as the base for the connection point load forecasts.

Connection point load and demand forecasts will thus be based on the previous financial year load levels but will take into account more recent trends when preparing the forecast.

### 4.3.3 Method of Scaling

The 12 months of actual load data from the previous financial year needs to be modified to include the effects of load growth and any large known changes. These modifications include:

- large load changes (increase and decrease) at specific transmission connection points, including the anticipated timing as advised by the DNSPs and other participants; and
- scaling of the remainder of the load data to meet the forecast annual energy and the seasonal peak demands.

Appendix A of the NEMMCO Issues Paper [1] contains a discussion on some of the possible algorithms.

NEMMCO believes that the TNSPs are in the best position to choose a scaling method that is appropriate for each connection point, depending on individual connection point characteristics.

### 4.3.4 Treatment of New Connection Points

Section 4.3.5 of the NEMMCO Issues Paper [1] discusses the forecasting of connection point load data for new connection points.

Confirmation of new or modified connection points by the beginning of January each year will allow NEMMCO sufficient time to include the modification in the loss factor calculations for the following financial year. The profile for the new or modified load at each trading interval, including possible impacts on adjacent connection points due to load shifting, should be provided by the relevant TNSP.

In the Issues Paper it was proposed that where the TNSP using reasonable endeavours is unable to provide an estimate of the profile by the end of January, a default load of not more than 1 MW would apply for each trading interval. The submissions to the consultation on the Issues Paper opposed this proposal and NEMMCO has therefore not included it in the draft methodology. It will thus be essential for the TNSP to provide a load profile estimate for each new connection point.

### 4.3.5 Treatment of MVAr

The load data used to calculate the loss factors and the loss factor equations must include forecasts of the connection point reactive power in addition to the real power. Section 4.3.6 of the NEMMCO Issues Paper [1] discussed the options for forecasting the connection point load reactive power requirements. NEMMCO considers that forecasting the reactive power requirements is integral to the forecasting the connection point real power and, therefore, the TNSPs would be best placed to forecast the reactive power requirements.

The TNSP would be required to consider the growth of the load, including new loads, and the likely operation of any embedded capacitor banks. One simple approach would be to assume that the additional capacitor banks and increased utilisation of existing capacitors would offset the additional reactive power requirements due to load growth.

### 4.3.6 TNSP Liabilities

TransGrid and VENCorp are concerned that the TNSPs would be exposed to additional liabilities if they prepare the connection point load forecasts. NEMMCO accepts that the connection point load data prepared by the TNSPs will be prepared in good faith. NEMMCO will perform due diligence on the data and will attempt to reconcile any concerns with the associated TNSP.

This issue is discussed further in section 7.5 of Appendix A.

## 4.4 Flows in Controllable Network Elements

### 4.4.1 Market Network Service Providers Networks

Section 4.4 of the NEMMCO Issues Paper [1] discusses forecasting the flows in existing and new MNSPs, including the proposed Basslink interconnector.

NEMMCO stated in their Issues Paper that they believe that the MNSP interconnector flows used to calculate forward-looking loss factors should be equal to the flows that occurred historically. That is, the MNSP flows would remain unchanged from the historical metered values corresponding to the trading periods associated with the historical transmission connection point load traces. This ensures that the relationship between the historical load traces and MNSP flows are maintained. Similarly, NEMMCO stated that they believed that the most appropriate approach is to assume zero flow (not more than 1 MW) on a new MNSP interconnection in the year in which the loss factors and loss factor equations apply.

Some of the submissions to the consultation on the Issues Paper supported NEMMCO's proposed approach while others proposed alternate approaches. NEMMCO believed that using purely historical flows for existing MNSPs and zero flow (not more than 1 MW) for new MNSPs is the approach that is most consistent with the principle of minimal extrapolation. This view was restated in the Draft Methodology [5].

NEMMCO received further submissions on this issue. NEMMCO considers that none of the proposals presented in these submissions provides sufficient reason for NEMMCO to change their proposed treatment of controllable network elements in their methodology. Sections 7.6 and 7.7 of Appendix A discuss these submissions further.

The Issues Paper [1] and the Draft Methodology [5] also discussed the proposal of treating Basslink as a special case. The majority of submissions considered that Basslink should be treated in the same manner as other new MNSP projects. That is, the Basslink flow will be assumed to be zero until there is historical flow data. Section 7.7 of Appendix A discusses this further.

### 4.4.2 Regulated Controllable Network Elements

It is possible that in the future a regulated controllable link may be operating in parallel with a regulated uncontrolled interconnector[5].

NEMMCO considers that a controllable regulated network element in parallel with other regulated network elements should be treated by applying a scaling factor equal to the ratio of the capabilities of the network elements, with separate ratios for positive and negative flows where the capabilities of the network elements are not symmetrical. This will prevent counter-flow situations where one regulated element has a counter flow to another regulated element. NEMMCO will implement separate interconnector limits for the controllable regulated network element.

## 4.5 Issues Associated with Forecasting Generation Data

Clause 3.6.2A(b) requires the development of a methodology for forecasting generation data for the financial year in which the loss factors and loss factor equations apply. The following issues need to be considered when forecasting the generation data.

### 4.5.1 The Minimal Extrapolation Approach to Forecasting Generation Data

Section 4.5.2 of the NEMMCO Issues Paper [1] discusses the market simulation and minimal extrapolations approaches to forecasting generating data. The majority of submissions to the consultation on the NEMMCO Issues Paper [1] support the minimal extrapolation approach.

One submission to the Draft Methodology [5] disagrees with the use of Minimal Extrapolation and suggests that a production cost based market model should be used. NEMMCO does not consider that it is practicable to obtain the necessary production cost data and this is discussed further in section 7.1 of Appendix A. Therefore, NEMMCO has determined that it will use the minimal extrapolation approach.

### 4.5.2 Historical Generation Data

Under the minimal extrapolation approach the forecast generation data set is based on the historical generation data. The historical generation data will be obtained from the previous financial year to be consistent with the connection point load data and MNSP flow data.

[5] At the time NEMMCO prepared the final forward-looking loss factor methodology the ACCC was considering an application for Murraylink MNSP to be classified as a prescribed network service. If this application is successful then a regulated controllable network element (Murraylink) will be operating in parallel with other regulated uncontrollable network elements (Heywood and SNI).

### 4.5.3 Creating Generating Data for New Generating Units

Section 4.5.3 of the NEMMCO Draft Methodology [5] proposes the following approach for new generators:

identify all the generating units in the NEM that are similar to the new unit (i.e. similar technology and fuel costs that are within about 20 %);

determine the historical generation for each of the units identified in (1) for each trading interval as a proportion of the winter rating specified in the NEMMCO SOO [2]; and

calculate the output of the new generating unit from the volume weighted average of the units identified in (1).

Exceptions to this approach are required for energy limited generators and generators that utilise a previously unused technology or fuel source.

The generation pattern for new energy limited generators, such as hydro or wind powered generators, would be more difficult to forecast. For new run of river hydro and wind powered generators NEMMCO proposes to use a profile equal to the average anticipated generation for each trading interval. For new hydro generators with significant energy storage NEMMCO proposes to consult with the proponent to determine an estimated generation profile. The proponents of new energy limited generating units will be obliged to provide to NEMMCO the anticipated utilisation of the generator.

For new generators that utilise a previously unused technology or fuel source then it would be necessary to identify existing generators that would have similar behaviour to that anticipated for the new generator. The proponents will be obliged to assist NEMMCO identify a similar generating unit or, failing that, to provide NEMMCO an estimate of the anticipated utilisation for each trading interval of the financial year in which the loss factors are to apply.

For both new energy limited generators and generators utilising new technology NEMMCO would adopt the mechanism described in Appendix C of the Issues Paper [1] to ensure the information supplied by the proponent is reliable.

### 4.5.4 Verification of New Generating Units

It is important that the list of new generators is accurate. Where either a generator is:

- included in the list but not subsequently built; or
- not included in the list but subsequently built,

then the flows in the network and the associated loss factors could be significantly different to those that would arise if the correct assumptions are made about the commitment status of all generators.

Including a generator that is not subsequently built will tend to incorrectly lower the loss factors of neighbouring connection points. Similarly, not including a generator that is subsequently built will tend to incorrectly raise the loss factors of neighbouring connection points. In the case of a very large generator the impact on losses may be significant.

As discussed in section 4.5.4 of the Draft Methodology [5], NEMMCO believes that only the generating units that are included in the latest NEMMCO SOO or an Update [2] as existing or committed generators should be included in the generating data. The commitment criterion used for new generators is the same as the criterion in section 4.2.2 that is used for new network augmentations.

It is not proposed to develop 'claw-back' provisions for incorrect forecasts.

### 4.5.5 Reducing Generation to Restore Supply/Demand Balance

Section 4.5.5 of the NEMMCO Draft Methodology [5] discusses how the minimal extrapolation methodology would be applied for the trading intervals where the forecast dispatch of new generation exceeds the load growth.

In the Draft Methodology NEMMCO proposed scaling the historical output of the existing generators, and the anticipated output of the new generators, to restore the supply demand balance for periods where there is excess capacity. Energy limited plant such as hydro or transmission connected wind farms would not be adjusted. NEMMCO now intends to adapt this approach in the methodology.

### 4.5.6 Increasing Generation to Restore Supply/Demand Balance

In sections 4.5.6 and 4.5.7 of the NEMMCO Draft Methodology [5] discuss how the minimal extrapolation methodology would be applied for the trading intervals where the forecast dispatch of new generation is less than the load growth.

In the Draft Methodology NEMMCO proposed scaling the differences between the historical output and the capacity of each existing generating unit until the units reach their capabilities, where the definition of unit capacity is discussed further in section 4.5.7. When increasing the output of existing generating units the following order would be applied:

- generators that were operating at that trading interval ("ON");
- generators that were not operating at that trading interval ("OFF") and offered as available;
- generators that were not operating at that trading interval ("OFF") and offered as unavailable;
- energy limited generators; or
- generators at the regional reference nodes (RRN) offered at VoLL.

Dispatch of a generator at VoLL is equivalent to load shedding and discussed further in section 7.10.

### 4.5.7 Generator Capacity

Section 4.5.8 of the Draft Methodology [5] discusses which value of maximum capacity for each generating unit. Possible definitions include:

- the maximum historical output produced by the generator in that season (separate values for summer and winter);
- the historical availability offered into the pool by trading interval; or
- the maximum output values specified in the NEMMCO SOO [2] for summer and winter.

NEMMCO believes that the most appropriate choice is values that are published in the most recent SOO [2], using separate values for summer and winter. This is discussed in section 7.12.

The maximum output values specified in the NEMMCO SOO are on a generator terminal basis while the loss factors are calculated on a sent out basis[6]. Therefore, NEMMCO will estimate the auxiliaries requirements for each unit at peak conditions using historical data from the NEMMCO energy management system (EMS) and settlements database.

[6] The definitions of generator terminal and sent out are given in the NEMMCO SOO [2].

### 4.5.8 Minimum dispatch levels

As discussed in section 4.5.9 of the Draft Methodology [5], many generating units in the NEM have technical limits on their minimum dispatch levels. Typical minimum dispatch levels for black and brown coal generating units are approximately 40% and 70 % respectively [4].

NEMMCO recognises that the methods for adjusting generation described in section 4.5.5 may cause some generating units to be dispatched below their minimum dispatch levels, however, NEMMCO considers that the effect on the resulting loss factors would not be material because the primary exercise is to forecast network flows rather than the output of specific generating units.

### 4.5.9 Mothballed generation

The opportunity also exists to set to zero the output of generators that will be mothballed during the year for which the marginal loss factors apply. The list of mothballed plant, and the associated timing, would be verified by the latest SOO or the latest Addendum.

### 4.5.10 Accounting for Interconnector Limits

Section 4.5.11 of the NEMMCO Draft Methodology [5] discusses the impact of interconnector limits on the methodology. The methods for calculating the interconnector limits that were discussed were:

- using the historical interconnector limits for each trading interval from the previous financial year;
- simplifying the actual interconnector equations to represent system conditions; or
- using the fixed limits obtained from the SOO [2].

As discussed in section 7.18 of Appendix A, NEMMCO considers that the interconnector limits are generally close to the values in the SOO when the network is intact and therefore considers the SOO values are appropriate.

NEMMCO proposes to implement systems that would allow the use of individual interconnector limits for each trading interval. NEMMCO intends to implement representative interconnector limits for summer and winter, and peak and off peak periods. NEMMCO will consult with the TNSPs when developing these representative limits.

### 4.5.11 Generator Planned and Forced Outages

Section 4.5.12 of the NEMMCO Draft Methodology [5] discusses the treatment of generator outages.

As discussed in section 7.17 of Appendix A, NEMMCO considers that using the actual generation by trading interval to define the outages is the most robust approach as it requires no subjective assumptions while providing the correct long term signals. This approach is also consistent with the principle of minimum extrapolation.

### 4.5.12 Generator MVAr and Voltage Profile

NEMMCO, the Reference Group[7] and the submissions recommend allowing the reactive output of generators to be determined automatically as part of the load flow solution. This is discussed further in section 4.5.13 of the NEMMCO Draft Methodology [5].

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7 NEMMCO established a reference group to in the preparation of the Issues Paper [1].

## 4.6 Connection points defined after the loss factors are published

Section 4.5.12 of the NEMMCO Draft Methodology [5] discusses the requirements of Clause 3.6.2A(g) for the calculation of the loss factor for a transmission connection points that is established in the financial year in which the intra-regional loss factor is to apply.

As discussed in section 7.13, Clause 3.6.2A(g) of the gazetted RIEMNS Stage 1 Code changes no longer requires that the forecast load and generation data used to calculate the intra-regional loss factor for the transmission network connection point be based on the forecast load and generation data for the same region.

Therefore, NEMMCO will calculate the MLF for a connection point that is defined after the loss factors are published using the dataset used to calculate the most recently published MLFs.

## 4.7 Calculating the Intra-regional MLFs

### 4.7.1 Volume Weighting

Section 4.7 of the NEMMCO Draft Methodology [5] discusses volume weighting of the intra-regional loss factors.

The use of time weighted loss factors and including the spot price in the weights are both considered in the Issues Paper [1] but were not considered to be compliant with the gazetted RIEMNS Code changes. The only exception would be to use time weighting of loss factors when the forecast generation for a unit is zero for every single trading interval in the financial year in which the loss factor apply.

Therefore, NEMMCO will use volume weighting of all intra-regional loss factors except where the forecast generation for a unit is zero in the financial year in which the loss factor apply.

### 4.7.2 Load Flow Instability

At present the automated load flow package TPRICE used my NEMMCO to calculate the loss factors is limited to a single load flow configuration with fixed generator voltage profile and fixed transformer taps. However, the load and generation data represents each trading period in the financial year, including both maximum and minimum system loads.

TPRICE converges for the majority of the trading periods but the load flow solution for some individual trading periods can be unstable. The TPRICE load flow solutions can be made more stable by converting some of the load buses to voltage control buses. It can be argued that this mimics the actions of the system controller who maintains the network’s voltage profile.

In previous years NEMMCO has needed to convert a number of load buses to voltage control buses. NEMMCO also understands that Powerlink use a number of voltage controlled buses to improve the load flow stability when they calculate forward-looking loss factors Queensland.

When NEMMCO calculates forward-looking loss factors it will also be necessary to use a number of voltage control buses to improve the stability of the load flow solution. The use of voltage controlled buses would be limited, with the majority being on the backbone of the main high voltage network.

## 4.8 Estimating Inter-regional Marginal Loss Factor Equations

A single static loss factor between adjacent RRNs does not adequately define the loss factors between regions because of the variability of the associated inter-regional flows. Therefore, the inter-regional loss factors are represented by equations, known as inter-regional loss factor equations, which are solved for each dispatch interval using key power system variables.

Section 4.7.1 of the NEMMCO Issues Paper [1] examines the use of regression analysis to estimate the inter-regional marginal loss factor equations from the TPRICE output, while section 4.7.2 provides the process involved.

The methodology NEMMCO will use to is described in section 5.7.

## 4.9 Modelled Generator and Load Data

Section 4.7.3 of the Issues Paper considers modelling generator and load data. Under clause 3.6.2A(i), modelled data is required when the range of forecast load and generation data does not result in inter-regional flows that span a major portion of the transfer capability of the regulated interconnector.

The interconnector flows can be manipulated by scaling the generation or load data to change the interconnector flow to the desired value. This distorts the flows in the associated regions but is necessary when the range of forecast flows is too small, to allow the development of an inter-regional marginal loss factor equation. This may be required, for example, when a new regulated interconnector is commissioned. Where modelled flows are required a random distribution of flows would be used.

NEMMCO considers that if the forecast interconnector flows cover more than approximately 75% of the technically available range of the interconnector flows then modelling data is unnecessary.

## 4.10 Other Methodology Issues

### 4.10.1 Multiple Connection Points at the Same Physical Connection

Section 4.8.2 of the NEMMCO Issues Paper [1] examines the situation where multiple participants are connected to the same physical connection point. This is discussed further in section 7.21 of Appendix A.

NEMMCO believes that each connection point should have a loss factor that is based on the energy traded at that connection point. However, where separate connection points are defined for different participants connected to the same busbar NEMMCO will calculate separate loss factors.

### 4.10.2 Pump Storage Schemes and MNSPs

Section 4.8.3 of the NEMMCO Issues Paper [1] discusses whether pump/storage schemes should have separate loss factors for pumping and generating. The similar issue of whether MNSPs should have separate loss factors for each direction of power transfer was raised in consultation.

Pump storage facilities, MNSP connection points and some other connection point may have characteristics where the net energy absorption is almost equal to the net energy generation or vice versa. The weighting methodology may yield unexpected (but correct for the assumptions) loss factors for this type of connection point. The existing weighting methodology works adequately unless the energy balance is within a few percent of being balanced.

NEMMCO considers that providing a separate loss factor for each direction of power flow for these connection points is the most appropriate solution. This approach has been adopted successfully at a pump storage connection point. However, NEMMCO cannot insist on the establishment of two metering points. As the problem only affects a small number of connection points, it is NEMMCO's preference to deal with the issue on a case by case basis, with a preference being given to the establishment of two metering points for those connection points where a near energy balance exists. Where NEMMCO becomes aware of such situations, it will seek to encourage the relevant proponent to establish the additional connection point.

As far as the methodology is concerned,

- a methodology as described in section 5.6.1 will be applied at connection points where a single metering point is provided; and
- two loss factors be determined, one for each direction of energy flow, where two metering points are available.

These issues are discussed further in section 7.19 of Appendix A.

### 4.10.3 New and Modified Connection Points

Section 4.8.4 of the NEMMCO Issues Paper [1] indicates that the loss factor methodology will need to include provisions for new connection points (loads or generators) that are defined after 1 April. New connection points can be defined at anytime and often only a few months before they are utilised.

### 4.10.4 Applying Loss Factors from 1 October rather than 1 July

Section 4.8.7 of the NEMMCO Issues Paper [1] discusses the option of changing the year in which loss factors apply from year ending 30 June to year ending 30 September. This is discussed further in section 7.23 of Appendix A.

NEMMCO is currently bound to develop the methodology on the basis that the loss factors apply for a financial year.

# 5 Forward-looking Loss Factor Methodology

This section sets out the Forward-Looking Loss Factor (FLLF) methodology This section describes the AEMO methodology for calculating forward-looking loss factors. AEMO uses to " calculate MLFs. An overview of this methodology is illustrated below. The data requirements for the methodology are listed in Appendix B.


- Network Representation - develop a load flow model of the transmission network that includes committed augmentations for the year that the MLFs apply.
- Controllable Network Elements - Obtain connection point demand forecasts for the year that the MLFs apply.
- New and Retired Generation - Estimate the dispatch of committed new generating units and remove retiring units.
- Generation extrapolation - Adjust the dispatch of new and existing generating units to restore the supply-demand balance using the rules in the FLLF methodology.

Calculation - calulate the MLFs using the resulting power flows in the transmission network.

The methodology was developed in accordance with the Code consultation procedures.

## 5.1 Network representation

### 5.1.1 Identify Future Augmentations

AEMO will consults with the TNSPs to develop a list of committed transmission augmentations that are committed to be commissioned during the financial year for which the loss factors are to apply.

The TNSPs must confirm that the transmission augmentations have satisfied the commitment criterion in the current AEMO Electricity Statement of Opportunities (ESOO) [2] [8].

The TNSPs must supply AEMO with sufficient network data for the augmentation to be represented in the network model.

### 5.1.2 Prepare the Base Case Load Flow File

AEMO takes Aa single snapshot of the NEM transmission network would be taken from the AEMO Eenergy Mmanagement Ssystem (EMS). AEMO then will modifiesy the snapshot to:

- include all known connection points (existing and planned);
- represent anticipated system normal operation;
- include all committed network augmentations; and
- have a voltage profile that is representative of high load conditions.

The network model will needs to contain all registered connection points., including those not currently represented in the AEMO's EMS .

## 5.2 Connection point load data

5.2 The forecast load at a Cconnection point is to load forecast data will be based on historical data from the previous financial year, and will be produced by either A-EMO or the TNSP. These connection point load forecasts will be produced by either AEMO or the TNSPs of each region..

### 5.2.1 Obtain Provision of historical dataload data to TNSPs

If requestedrequired, AEMO I must provides tothe relevant TNSPs, when requested, relevant with draft hhistorical connection point load data for the previous financial year by 15 October each year. This data may be used by the TNSP to develop connection point load forecasts for the MLF study year.

### 5.2.2 TNSP fForecasting connection point dataload

Either AEMO or Ethe eThe TNSPs must produces their draft connection point load forecasts data for each load connection point in itstheir jurisdiction by 15 January each year. These forecasts are: should:

- be based on the historical connection point data (retaining the same weekends and public holidays);

[8] Within this methodology the NEMMCO SOO [2] refers to the current NEMMCO Statement of Opportunities or the latest update, as specified in clause 3.13.3

- be consistent with the latest annual regional load forecasts prepared by AEMO or the TNSP;
- be based on 50 % probability of exceedence and medium economic growth conditions, as described in the ESOO; [2];
- to include the impacts of any known new loads;
- to include the impact of existing and committed generation that is embedded in the distribution network; and
- an provide an estimate of the real and reactive power at each connection point for each trading interval.

**Appendix A of the NEMMCO Issues Paper [1] contains a description of a number of methods for scaling historical connection data to match annual energy and maximum demand forecasts. AEMO believes that the TNSP should select the methodology that they believe is most appropriate for each individual connection point.**

### 5.2.3 AEMO due diligence

If the TNSP provides the connection point forecasts are provided by TNSPs, AEMO reviews must perform due diligence checks of the data supplied by the TNSPs and ensures that the, including:

- ensure that the aggregated connection point load annual energies ?? (accounting for estimated transmission losses) match the current AEMO ESOO [2];
- the ensure aggregated maximum demand matches the current AEMO ESOO (accounting for estimated transmission losses and generator auxiliaries); and
- checks of the differences between the historical and forecast data for selected connection points are acceptable?.

AEMO and TNSPs must consult with the associated TNSPs consult toto resolve any apparent discrepancies in the connection point data.

### 5.2.4 Absence of forecast data from a TNSP

AEMO will generate the forecasts of the connection point load data for a jurisdiction if the relevant TNSP is unable to supply AEMO with the connection point load data by 15 January each year i.e. in sufficient time to calculate and publish the loss factors by 1 April.

The methodology AEMO would use to scale the connection point load data is to:

- determine the increase in the annual energy and maximum demand for the relevant jurisdiction from the current AEMO ESOO [2];
- net out the fixed loads (eg smelters);
- allocate the increase in the annual energy and maximum demand to the individual connection points in proportion to the historical annual energy and maximum demand;
- scale the historical connection point loads using the “linear proportional push-pull” methodology described in of Appendix B; and
- assume that the additional capacitor banks and increased utilisation of existing capacitors would offset any change in the reactive power requirements of the load.

## 5.3 Flows in Controllable Network Elements

Controllable network elements include comprise of both MNSPs and controllable regulated network elements.

### 5.3.1 Controllable Network Elements with historical flow data

AEMO will assumes that the flows in controllable MNSP network elements are unchanged from the historical flows. If flows in controllable MNSP network elements are likely to change in response to modified generation profiles in accordance with section 5.5.6 or 5.9, then AEMO adjusts historical flows on controllable MNSP network elements will be adjusted to substantially represent the extent of reflect the aggregated change in generation profiles.

Where a controllable regulated network element in parallel with other regulated network elements AEMO will uses a scaling factor equal to the ratio of the capabilities of the network elements, with separate ratios for positive and negative flows where the capabilities of the network elements are not symmetrical.

### 5.3.2 New Controllable Network Elements

AEMO will assumes that the flow is zero (not more than 1 MW) for each trading interval when there is are no historical flow data for a new or recently commissioned controllable network element for the whole previous year.

AEMO will treats models? new regulated controllable network elements in parallel with other regulated network elements in the same manner as? existing regulated controllable network elements in parallel with other regulated network elements.

## 5.4 Estimate new generator output and retired generating units

AEMO estimates Tthe initial dispatchestimate forof athe new generator dispatch will be determined from the generation patterns of similar generating unit using the . The following stepsprocedure will be used.

### 5.4.1 Obtaining a list of committed new generators

AEMO calculates loss factors based on the list of committed and existing generators published in the current AEMO ESOO and until **15 January** from the AEMO Generation Information Page ?. AEMO is obliged to publish the ESOO by 31 August each year. AEMO will calculate loss factors based on the list of committed and existing generators published in the current AEMO ESOO [2] and until **15 January** from the AEMO Generation Information Page [6].

### 5.4.2 Estimating the dispatch

AEMO assumes Tthe output of a new committed generating units to be will be assumed to be zero for trading intervals prior to the committed commissioning date[9] reported in the current AEMO ESOO.

The process for calculating an initial estimate of the output of the committed new generators following their commissioning iswill be:

- identify similar existing generating units in the NEM that use similar technology and fuel type, and are up to 5 years old;
- use data that is up to 10 years old for similar units where no similar existing units are availablefound units up to 10 years old would be considered;

9 Within this methodology the commissioning date is defined as the anticipated date of commercial service.

- find the average output of the similar generating units as a percentage of their winter rating from the current AEMO ESOO [2]; and
- determine the output of the new generating units by scaling the average output profile by the nameplate rating of the new unit.

A new generating unit Iin the second year of operation a new generating unit will - generally have an incomplete year of's historical data forrom the previous financial year. In this case AEMO will uses the methodology above to estimate the dispatch for the period prior to the historical data being available.

### 5.4.3 Transmission connected hydro and wind generating units

AEMO will consults with the proponent of a new transmission connected hydro or wind generating unit to determine the anticipated generation profile. Where the proponent is unable to provide this profile then AEMO will uses a flat generation profile equal to the product of the anticipated utilisation factor and the nameplate rating for new run of river hydro units and wind powered units. For new hydro generators with significant energy storage AEMO will consults with the proponent to determine an estimated generation profile.

AEMO will usesadopt the mechanism described in Appendix CA of the Issues Paper [1] to ensure the information supplied by the proponent is reliable.

### 5.4.4 Previously unused technologies and fuel types

For new generators that utilise a new technology or fuel type AEMO will adopts the mechanism described in Appendix CA of the Issues Paper [1] to ensure the information supplied by the proponent is reliable.

### 5.4.5 Retired generating units

The generating units that are retiring in the financial year in which the loss factors apply are identified in the current AEMO ESOO [2] and AEMO Generation Information Page [6]. Retiring plant is will be represented by setting their forecast MW and MVAr output to zero from the retirement date specified in the SOO and until **15 January** from the Generation Information Page [6].

AEMO will consults with the registered owners of the retiring generating unit if the information in the SOO or Generation Information Page is insufficient to provide an exact retirement date.

## 5.5 Extrapolating the generation to balance supply and demand

AEMO uses Tthe minimal extrapolation principle will be used to balanace supply and demand[A1]. Under the minimal extrapolation approach the forecast generation data is based on the historical generation data. AEMO uses generation data from the previous financial year as hThe historical generation data. AEMO then adjusts the used will be from the previous financial year.[A2] The historical generating unit data output of the generating units then need to be adjusted to restore the balance of supply and demand. This is subsequent to following the updating of the network model, the scaling of the connection point loads, and the includinginclusion of any committed new generating units.

For purposes of this methodology, the availability of a generating unit is used to denote the level to which it can be dispatched. An availability of zero means the generating unit is unavailable for dispatch. A generating unit would be considered available in a period if its declared availability in the equivalent historic period was greater than zero. AEMO will obtains the availability status of each generating unit for each trading interval from their market datasystems. The availability of a generating unit is a factor that is taken into consideration in the adjustment of the supply / demand balance for those trading periods when it is necessary to increase the level of generation. This is discussed in Section 5.5.2.

### 5.5.1 Trading intervals of excess generation

There will be an excess of generation for each trading interval where the forecast connection point loads have grown by less than the initial forecast of the output of the new generating units[10]. For these trading intervals the net generation will need to be reduced by scaling the output of all the generators in proportion to their historical output. It is not practicable to consider the minimum dispatch levels of the units.

The output of energy limited generators, including pump operation, would not be adjusted.

The initial estimate of the output of the new generators would be scaled in the same manner as the historical output of the existing generators.

### 5.5.2 Trading intervals with a shortage of generation

There will be a shortage of generation for each trading interval where the connection point loads have grown by more than the initial estimate of the output of the new generating units[11] [see footnote 8]. For these trading intervals the net generation will be increased using the following priority:

- the spare capacity of non energy limited generating units that are currently running (ON) is dispatched in proportion to the spare capacity of each unit;
- the capacity of the non energy limited generating units that were not running (OFF) but available is dispatched in proportion to the capacity of each unit;
- scheduled pumps are reduced in proportion to their historical load;
- the capacity of the non energy limited generating units that were not running (OFF) and are unavailable is dispatched in proportion to the capacity of each unit;
- the spare capacity of hydro generating units is dispatched in proportion to the spare capacity of each unit; then
- VoLL generators are dispatched at the reference nodes.

The output of transmission connected wind farms would not be adjusted.

The initial estimate of the output of the new generators developed in section 5.4 would be scaled in the same manner as the historical output of the existing generators.

### 5.5.3 Generator capacities

The historical generation data is usually on a sent out basis, that is, the net output of the generating unit less the station auxiliary load. AEMO will estimate the sent out capacity of each unit for both summer and winter by subtracting an estimate of auxiliary load from the generator terminal capacity in the current SOO. AEMO will need to estimate the auxiliaries from the difference between the SCADA generator terminal output, as obtained from the AEMO EMS, and the settlements value for the same trading interval. In the cases where the auxiliaries are separately measured or negligible then AEMO will not need to correct the historical generation data

The maximum capacity of each of the NEM generators will be set equal to the value specified in the current AEMO ESOO [2] and until **15 January** in the AEMO Generation Information Page [6]. A separate value should be used for summer and winter, where summer would be defined as 1 December to 31 March.

10 Network augmentations also affect the supply/demand balance by altering the network losses.

11 Network augmentations also affect the supply/demand balance by altering the network losses

#### 5.5.3.1 Reductions in capacity

If the capacity of a generating unitor is forecast to be reduced for reasons other thatn for maintenance, the the reduced capacity will be used. If the capacity has been restored from a reduced capacity in the prior year(s), then AEMO in consulation with the registered owner will backfill the historical profile of the generating unitor to represent the restored capacity.

#### 5.5.3.2 Reductions in capacity due to maintenance

If the capacity of a generating unitor is forecast to be reduced for maintenance reasons, AEMO will ignore the capacity reduction. AEMO will consulat with the registered owner too make a determine if the forecast capacity reduction is to model a maintenance outagemaintenance related.

The historical generation data is usually on a sent out basis, that is, the net output of the generating unit less the station auxiliary load. AEMO will estimate the sent out capacity of each unit for both summer and winter by subtracting an estimate of auxiliary load from the generator terminal capacity in the current SOO. AEMO will need to estimate the auxiliaries from the difference between the SCADA generator terminal output, as obtained from the AEMO EMS, and the settlements value for the same trading interval. In the cases where the auxiliaries are separately measured or negligible then AEMO will not need to correct the historical generation data.

### 5.5.4 Interconnector limits

The inter-regional transfers will be maintained within the summer and winter interconnector limits specified for the supply/demand balance presented in the current AEMO ESOO [2] for the year in which the loss factors apply.

The generation in different regions may need to be adjusted to keep inter-regional flows within the respective transfer capabilities anticipated for the year in which the loss factors apply. This requirement could arise through the interaction of the interconnector limits with the patterns of load growth and new generation.

AEMO will implement representative interconnector limits for summer and winter, and peak and off peak periods. AEMO will consult with the TNSPs when developing these representative limits. These limits will be consistent with the limits described in the current AEMO ESOO.

### 5.5.5 Treatment of generators and load that can switch between connection points

A generator or load may be switchable between two (or more) physical connection points. An example is Yallourn unit 1 that can either be connected to the Victorian 500 kV or 220 kV networks. Generally, the load or generator metering data can be separated into the data for each of the physical connection points. Separate loss factors are calculated for the physical connection points and these loss factors are later volume weighted to give a single loss factor for the unit.

Under the principle of minimum extrapolation, AEMO will assume that for the trading intervals where the unit is ON the connection point is unchanged from the state in the historical generator data. Further, when the unit is OFF but is required to be dispatched then AEMO will assume that the connection point state has not changed since the last known state.

However, the operator of a switchable load or generating unit may consider that in the year the loss factors apply the switching pattern of their unit will differ significantly from the historical switching pattern. If the operator expects that the unit generator switching differs by more than five days in aggregate then the associated TNSP would, in consultation with the operator of the unit, prepare the switching profile that is anticipated for the year in which the loss factors will apply. This is discussed further in sections 17.22 and 09.1.

### 5.5.6 Accounting for abnormal conditions affecting NEM generation patterns

Where a Generator believes its historical generation profiles are not an accurate predictor of future generation profiles, it may provide to AEMO by 15 November, an adjusted generation profile. AEMO will then review the adjusted generation profile, and consider whether to use the adjusted generation profile in lieu of the historical generation profile provided:

- Requests for generation profile revision come from the owner or operator of a generating unit or generating system;
- Historical generation profiles must be shown to be obviously not representative of the expected generation profile in the next year;
- Revised generation profiles are independently verifiable and are based on physical circumstances only, such as:
  - drought conditions;
  - low storage levels or rainfall variability for hydroelectric generators;
  - major plant failures resulting in forced outages of greater than four weeks;
  - failure in the supply chain impacting on fuel availability;
- Revised generation profiles are not market-related or arise as a result of the financial positions of Generators; and
- Adjusted generation profiles are not be confidential, as AEMO will publish them along with its reasoning for using an adjusted generation profile as part of the report accompanying the issue of the MLFs.

AEMO may seek an independent review of any adjusted generation profile submitted by a Generator.

If AEMO accepts an adjusted generation profile, then this information will be published on 1 April. The information will be aggregated quarterly on a regional or sub-regional level. AEMO will also historically review how adjusted generation profiles compared with actual generation profiles and publish information summaried as above.

AEMO will calculate and publish indicative extrapolated generation data in October to assist market participants to identify manifestlygrossly incorrect historical generation data. The calculation will be approximate and will

- only reflect information known at the time
- only include exisiting and significantmajor new connection points
- only include an approximate load forecast
- be based on the previous year's network model, and will not include new augmentations

**5.5.7** Where a generation pattern appears to have been affected by "unforeseen circumstances", a generator may provide to AEMO by **15 September**, an adjusted generation profile. AEMO will then review the adjusted profile provided by the generator, and accept or reject the proposal on the basis of sufficient reasoning for providing an adjusted profile.

"Unforeseen circumstances" may refer to physically uncontrollable cases, such as:

- drought conditions
- major plant failures which result in significant forced outages of greater than four weeks
- failure in the supply chain impacting on fuel availability

## 5.6 Calculating the intra-regional static loss factors

AEMO will use TPRICE[12] or an equivalent to calculate loss factors. The TPRICE algorithm can be summarised as:

- a load flow is solved for each trading interval using the supplied generation and load data;
- the marginal loss factors defined with respect to the load flow swing bus (usually Murray power station)[13] are calculated for each connection point and trading interval from the Jacobian matrix;
- the marginal loss factors defined with respect to the associated regional reference node (RRN) are calculated for each trading interval as the ratio of the connection point loss factor to the associated RRN loss factor; and
- for each connection point, the marginal loss factors (with respect to the RRN) for each trading interval are volume weighted by connection point MLFs (with respect to the RRN) to give the static MLF.

AEMO may include a number of voltage control buses to improve the stability of the load flow solution. The use of voltage controlled buses would be limited and would mainly be located on the backbone of the main high voltage network.

[12] The TPrice application calculates the loss factor for each connection point and regional reference node (RRN) referred to the load flow swing bus defined in the network model. The loss factor of connection point A referred to connection point B is defined as the ratio of their respective loss factors with respect to the swing bus.

[13] The selection of swing bus does not directly affect the marginal loss factors with respect to the assigned regional reference node. There is a small effect on the flows in the network flows from changing the swing bus and this has a small indirect affect on the loss factors.

### 5.6.1 Calculating dual intra-regional static loss factors for a transmission network connection point

AEMO will calculate dual MLFs for transmission network connection points where a single MLF for the transmission network connection point does not satisfactorily represent transmission network losses for active energy generation and consumption. AEMO will:

5.6.1

A single intra-regional loss factor for pumped storage schemes exhibited significant distortion in 2009-10. AEMO subsequently carried out consultation followed by submitting a Rule change request to the AEMC to address this issue. The Rule change seeking amendments to clause 3.6.2(b)(2) of the Rules to allow AEMO to calculate dual MLFs for transmission network connection points where one MLF does not satisfactorily represent transmission network losses for active energy generation and consumption was approved by the AEMC on 29 June 2011.

The consultation carried out by AEMO on the criteria for application of dual MLFs to a connection point led to the following outcome,

(i) -Apply two MLFs to all transmission network connection points classified as Pump Storage Schemes; and

(ii) For all other transmission network connection points, apply two MLFs if the net energy balance (NEB) is less than 30%

The NEB threshold test is applied as follows:

Determined the percentage NEB by expressing the net energy at a transmission connection point as a percentage of the total energy generated or consumed at a transmission connection point, whichever is greater.

For example:

Energy generated = 10 GWh
Energy consumed = - 3 GWh

Therefore, % NEB threshold is

= (absolute value of the sum of energy generated and energy consumed) / (greater of the absolute value of energy generated or energy consumed)

= (10-3)/10 = 70%

## 5.7 Determining the inter-regional loss factor equations

### 5.7.1 Regression procedure

The inter-regional marginal loss factor equations will be determined using linear regression analysis. The procedure is as follows:

- the marginal loss factors for each of the RRNs, defined with respect to the swing bus will be extracted from the output of the TPRICE run used to calculate the intra-regional loss factors.
- for each pair of adjacent RRNs:

- the inter-regional marginal loss factors are calculated for each trading interval as the ratio of marginal loss factors of the associated RRNs; and
- the inter-regional loss factor equations are estimated by regressing the inter-regional marginal loss factors against the associated interconnector flow and selected regional demands.

The regional demands will be included in the inter-regional loss factor equations if they significantly improve the fit of the regression equation.

Where the fit of an inter-regional loss factor regression is poor then AEMO will consider using additional variables in the regression analysis, including:

- the output of specific generating units that affect the inter-regional losses (for example losses on QNI would be affected to some degree by generation at Millmerran); and
- transfers on other interconnectors.

Including these variables would require alterations to the AEMO market systems.

### 5.7.2 Inter-regional loss factors in the presence of loop flows

At present the regional model of the NEM is linear as the interconnectors between the regions do not form loops. Loop flows may be introduced in the future if additional interconnectors are built between regions that are not currently interconnected or the region model is modified.

If loops are introduced into the NEM regional model then the forward-looking loss factor methodology may need to be revised.

### 5.7.3 Modelled generator and load data

Where the range of interconnector flows is less than approximately 75 % of the technically available range of the interconnector flows or where the regression fit is considered to be poor then the load and generator data would be scaled power system modelling and in a power simulation tool to produce a set of randomly distributed flows covering the technically available range of the interconnector flows. The regression analysis repeated using the modelled data obtained from these flows.

The modelled generator and load data would not be used for calculating intra-regional loss factors.

## 5.8 Connection points defined after the loss factors are published

AEMO calculates loss factors for each connection point and loss factor equations for each interconnector and publishes the loss factors by 1 April prior to the financial year for which the loss factors are to apply. It is only possible for AEMO to calculate loss factors for connection points and interconnectors that are known to AEMO.

If a loss factor or a loss factor equation is required after AEMO has calculated and published the loss factors then a separate calculation is required. The proposed procedure for calculating such a connection point is discussed in the following sections.

### 5.8.1 Network representation

The network representation used to calculate the loss factors for the new connection point should be based on the network used to perform the most recent annual loss factor calculation.

The network representation will be modified to incorporate the new connection point. This may include addition of new or changed transmission elements or modifications to existing connection points.

### 5.8.2 Determine connection point data

The connection point load and generator data used to calculate the loss factors for the new connection point should be based on the connection point data used to perform the most recent annual loss factor calculation.

If the new connection point is a load then the relevant TNSP will need to supply AEMO with the load data for each trading interval following the commissioning of the connection point. If the new connection point is a generator then AEMO will determine an estimate of the dispatch for the new generator using the procedure in section 5.4.

### 5.8.3 Methodology

The procedure in section 5.5 will be applied to restore the supply/demand balance by making adjustments to the output of generating units. This would be the same procedure used by AEMO to perform the most recent annual loss factor calculation. The intra-regional loss factor for the new connection point would be calculated using the procedure in section 5.6.

When AEMO calculates the loss factor for a new connection point loss factor values for existing connection points in the vicinity may also be affected. However, when a new connection point is defined after the loss factors have been published then AEMO will not revise the published loss factors for the existing connection points.

### 5.8.4 Time requirements

Clause 3.6.2(l)(2) requires AEMO to use reasonable endeavours to determine and publish the intra-regional loss factor at least 45 business days prior to the commencement of operation of the established connection point.

For a new load connection point the relevant Code Participant needs to inform AEMO and the relevant TNSP that a new connection point is being established and a loss factor is required. The TNSP will require up to 45 business days to estimate the connection point load data. AEMO will require up to a further 30 business days to calculate and publish the loss factor.

For a new generator AEMO will require up to 40 business days to calculate and publish the loss factor.

The times in this section are estimates only. AEMO and the TNSPs will use reasonable endeavours to expeditiously perform the necessary calculation but the process relies on the relevant Code Participants supplying the necessary information promptly.

## 5.9 Unexpected and unusual system conditions

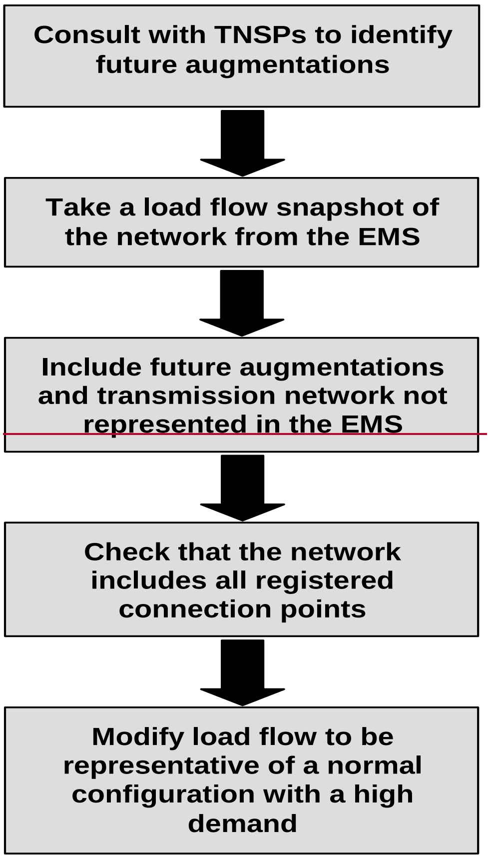
When developing this methodology, AEMO has used its best endeavours to cover all expected operating and system conditions that could arise when producing the load, generator and network dataset that represents the financial year in which the loss factors apply.

However, in practice some unexpected operating or system condition may arise that is not explicitly covered in the methodology. If this arises then AEMO will make a judgement based on the principles listed in the Code and in section 5. All such judgements that AEMO is required to make while developing the loss factors in a given year will be identified in the published report listing the loss factors.

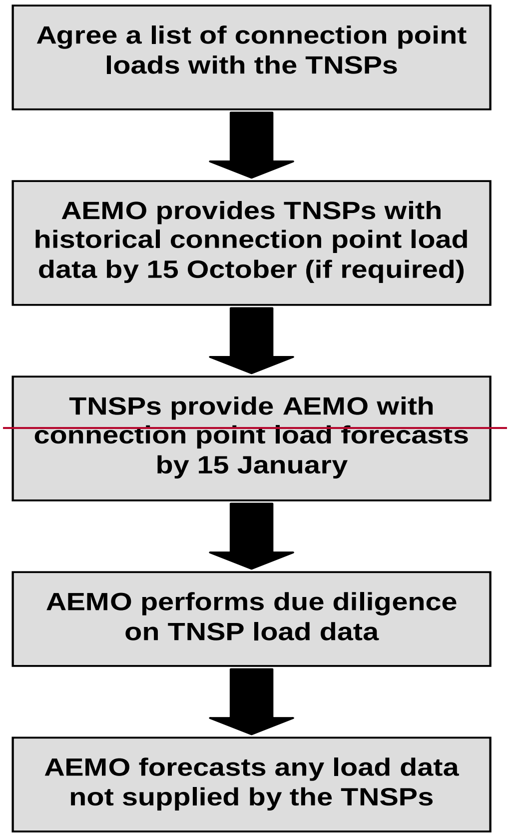
## 5.10 Methodology Flow Charts

This section contains indicative flow charts that represent the process to perform the forward-looking loss factor calculations.

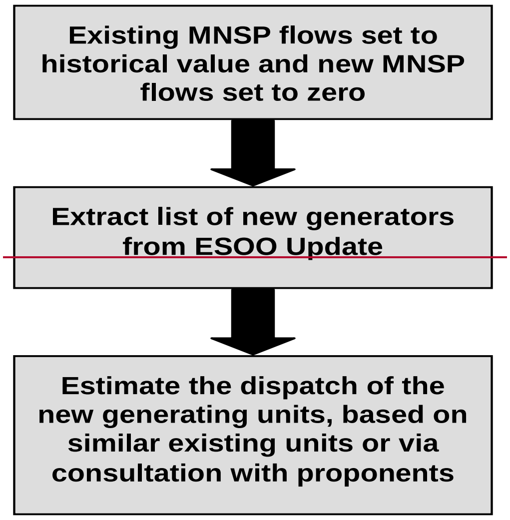
## Developing the network representation



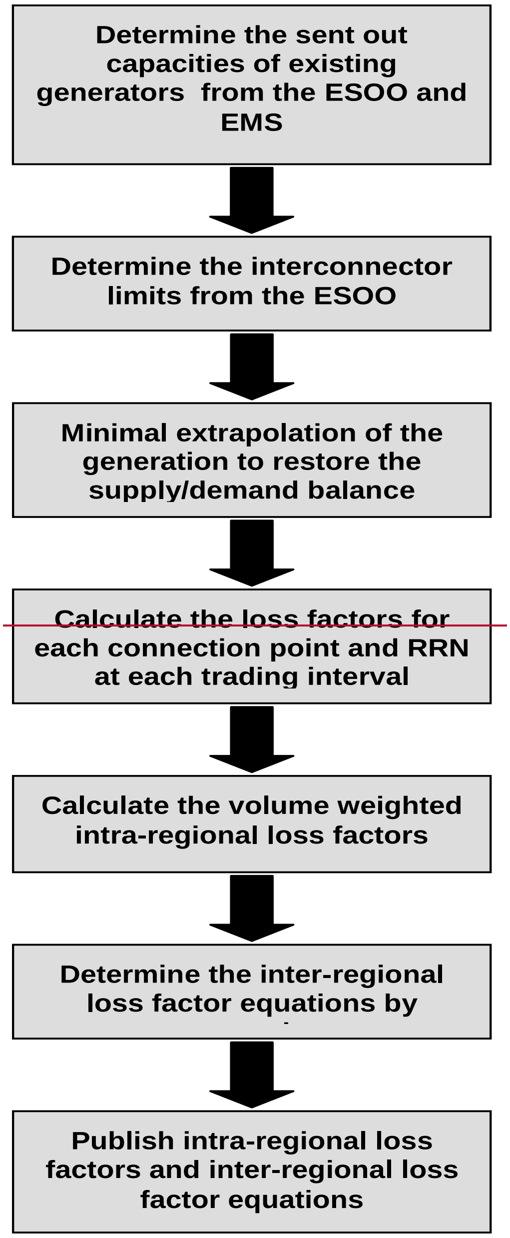
## Process to forecast the connection point loads




## Process to determine MNSP flows and new generator operation



Process of minimal extrapolation, and loss factor calculation and publication.



## 5.11 Data Required by AEMO

The following table summarises the data necessary for AEMO to implement the forward-looking loss factor methodology. The table includes a description and the source of each item of data.

| Data | Description | Source |
|---|---|---|
| *Existing Load Connection Points* | | |
| Connection point load | MW & MVAr by trading interval | Relevant TNSP (AEMO will estimate the data if it is not supplied) |
| *New Load Connection Points* | | |
| Estimated commissioning date | Date of commercial operation | ESOO, confirmed with proponent |
| Connection point load | MW & MVAr by trading interval | Relevant TNSP |
| *Existing generating units* | | |
| Generator terminal capacity for summer and winter | Summer and winter MW values | ESOO |
| Auxiliary requirements for summer and winter | Summer and winter MW values | AEMO estimate with consultation with the registered owner |
| Historical generation profile | MW by trading interval | AEMO settlements data |
| Availability status by trading interval | Status by trading interval | AEMO market systems |
| *New generating units* | | |
| Estimated commissioning date | Date of commercial operation | ESOO, confirmed with the registered owner |
| Nameplate rating | MW | ESOO, confirmed with the registered owner |
| Similar units | List of generating units | AEMO discussions with the registered owner |
| Generation profile of similar units | MW by trading interval | AEMO settlements data |
| *Existing MNSP* | | |
| Historical energy transfer profile | MW by trading interval | AEMO settlements data |
| *New MNSP* | | |
| Estimated commissioning date | Date of commercial operation | ESOO, confirmed with proponent |
| *Interconnector Capability* | | |
| Capacity in each | MW by trading interval | ESOO, in consultation with the TNSPs |

| Data | Description | Source |
|---|---|---|
| *Existing transmission network* | | |
| Network data and configuration | Load flow, representative of system normal | AEMO EMS and operating procedures |
| *Transmission network augmentations* | | |
| List of network augmentations | List of augmentations | AEMO ESOO, in consultation with the TNSPs |
| Estimated commissioning date | Date of commercial operation | AEMO ESOO, in consultation with the relevant TNSP |
| Network element impedances | Network element impedances | Relevant TNSPs |

## 6 References


[1] "Methodology for Calculating Forward-looking Transmission Loss Factors: Issues Paper", April 2002, published by NEMMCO on their internet site.

[2] "Electricity Statement of Opportunities", published by AEMO each year in accordance with clause 5.6.4, ISSN 1443-9050. Information to obtain the latest version of the ESOO or Update is available on the AEMO internet site.

[3] "Forward-Looking Method for Calculating Marginal Loss Factors in the NEM", prepared by the Network Losses Working Group and submitted to NECA in January 2000, and resubmitted in June 2001 following minor revision.

[4] ""IRPC Stage 1 Report - Proposed SNI Interconnector" version no: V014, 26 October 2001, available on the NEMMCO internet site.

[5] "Methodology for Calculating Forward-looking Transmission Loss Factors: Draft Methodology", October 2002, published by NEMMCO on their internet site.

[6] "Generation Information Page is published at: http://www.aemo.com.au/registration/registration.html

[7] "Details of the Rules Consultation completed by NEMMCO in February 2009 to amend the Methodology for Calculating Forward-looking Transmission Loss Factors: Final Methodology are published at: http://www.aemo.com.au/electricityops/178-0099.html

# 7 Appendix A: Issues Raised from the Consultation on the Forward-looking Loss Factor Draft Methodology

On 2 October 2002 NEMMCO published a Draft Methodology paper as part of their consultation on the methodology for calculating forward-looking transmission loss factors. The consultation on the Draft Methodology closed on 18 October 2002.

The following table lists the interested parties that made submissions to NEMMCO. The table identifies the abbreviations used in the issues matrix below.

| Interested Party | Abbreviation |
|---|---|
| Edison Mission Energy | E |
| Hazelwood Power | H |
| Powerlink Queensland | P |
| Stanwell Corporation | S |
| TransGrid | T |
| Yallourn Energy | Y |

These submissions raise a number of issues that are reference in the following issues matrix.

| No. | Issue | E | H | P | S | T | Y |
|---|---|---|---|---|---|---|---|
| 1 | Should the methodology be based on cost based market simulations? | X | X | | | | |
| 2 | Should multiple network configurations be used when calculating loss factors? | | | X | | X | |
| 3 | Is a Code change necessary to require DNSPs and Customers to supply connection point energy forecasts? | | | X | | X | |
| 4 | Is the timing of the load forecasts correct? | | | X | | | |
| 5 | Are the TNSPs exposed to additional work and liabilities when providing the connection point load forecasts? | | | | | X | |
| 6 | Should the flow on MNSPs be unmodified from the historical flow? | | | X | X | | |
| 7 | Should the flow on new MNSPs, including Basslink, be zero? | X | | X | X | | |
| 8 | How should the dispatch of new generating units be determined? | | X | | X | | |
| 9 | Should the energy used during commissioning be estimated when calculating the loss factors? | | | | X | | |
| No. | Issue | E | H | P | S | T | Y |
| 10 | Should load shedding be at the regional reference node or distributed? | | X | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ~~11~~ | ~~How should energy limited units be adjusted?~~ | | ~~X~~ | | | | |
| ~~12~~ | ~~How should the maximum available generator output be defined?~~ | | ~~X~~ | ~~X~~ | | | |
| ~~13~~ | ~~Should the data used for the calculation of the loss factor for a connection point defined during the year be confined to one region?~~ | | ~~X~~ | ~~X~~ | | | |
| ~~14~~ | ~~Should the process for scaling the output of generating units up and down be symmetrical?~~ | | ~~X~~ | | | | |
| ~~15~~ | ~~Should additional generation be primarily allocated to generating units with a low utilisation?~~ | | | | | | ~~X~~ |
| ~~16~~ | ~~How should generating units that were unavailable be dispatched?~~ | | ~~X~~ | | | | |
| ~~17~~ | ~~Should the treatment of forced outages be consistent with MTPASA?~~ | | | | ~~X~~ | | |
| ~~18~~ | ~~How should interconnector limits be treated?~~ | | | ~~X~~ | | | |
| ~~19~~ | ~~How should pump storage schemes be treated?~~ | | | ~~X~~ | | | |
| ~~20~~ | ~~Should generator loss factors always be calculated on a sent out basis?~~ | | | ~~X~~ | | | |
| ~~21~~ | ~~How should multiple entities at the same busbar be treated?~~ | | | ~~X~~ | | | |
| ~~22~~ | ~~How should generators and loads that can switch between connection points be treated?~~ | | | | | | ~~X~~ |
| ~~23~~ | ~~Should loss factors apply for the year starting 1 October rather than 1 July?~~ | | | | | ~~X~~ | |
| ~~24~~ | ~~Do the calculated standard deviations decoupled from variations between the regional reference node and Murray, the TPRICE swing bus?~~ | | | ~~X~~ | | | |
| ~~25~~ | ~~Should all associated data be published?~~ | ~~X~~ | | | | | |

## 7.1 Should the methodology be based on cost based market simulations?

**View of Interested Party**

**Edison Mission Energy believes that the only way to accurately model forward looking loss factors is to use a production cost based market model.**

**Hazelwood Power supports in broad principle the use of "minimal extrapolation".**

**NEMMCO Consideration**

**NEMMCO does not believe it is practicable to perform market simulations because:**

- **the actual production cost data required to perform such simulations is not available to NEMMCO and it would be difficult to obtain data which is acceptable to all parties; and**
- **market participants may employ bidding strategies that rely on information other than their costs.**

**NEMMCO discussed using market simulations in their Issues Paper and received a number of submissions that supported that the "minimal extrapolation" approach. There were no submissions on the Issues Paper [1] explicitly supporting the market simulation approach.**

## 7.2 Should multiple network configurations be used when calculating loss factors?

**View of Interested Party**

**Powerlink considers the use of one network model for the calculation of loss factors is appropriate and therefore accepts the approach indicated is the NEMMCO Draft Methodology.**

**Powerlink Queensland also considers that it is desirable for all network augmentations that are scheduled to be in service during the financial year for which the loss factors are being calculated to be included in the network model. Most of the network augmentations are timed to occur prior to the summer high demand period in September or October. Powerlink agrees with the use of the NEMMCO commitment criteria for future projects.**

**TransGrid consider that the majority of network augmentations are not necessarily commissioned in time for summer, especially in New South Wales.**

**NEMMCO Consideration**

**NEMMCO agrees with TransGrid that employing multiple network configurations is a more accurate approach that better reflects the commissioning dates of new augmentations. However, NEMMCO's existing systems do not permit a change to the network model during the year.**

**NEMMCO is investigating changes to their systems to permit more than one network model. NEMMCO proposes in the interim to use the methodology in this report until such time as multiple network capability is implemented. When the NEMMCO systems have been modified to include multiple networks then NEMMCO proposes to then divide the year into the three portions, i.e. July to October, November to February and March to June. NEMMCO advises the market that when this capability is available it will be used for the next loss factor calculation and the market will be informed.**

## 7.3 Is a Code change required to require DNSPs and Customers to supply connection point energy forecasts?

**View of Interested Party**

**Powerlink agrees that TNSPs are in the best position to provide connection point forecasts for the purposes of calculating loss factors. Powerlink notes that there is currently no obligation for DNSPs or customers to provide energy forecasts to their connecting TNSP, except in Queensland where a derogation exists.**

**TransGrid also believes that it would further streamline the methodology if Code Participants were required to provide the forecasts of their annual energy consumption at their point of connection to the relevant TNSPs and to meet the timing obligations of TNSPs in providing data to NEMMCO. Therefore TransGrid supports the amending of the National Electricity Code to give effect to this obligation.**

**NEMMCO Consideration**

**NEMMCO acknowledges that the Code does not require the DNSPs and customers to provide the relevant TNSPs with energy forecasts for their connection points, and this may be an issue in some jurisdictions. The ACCC condition of authorisation C6.1 does require Code participants to supply the information necessary for NEMMCO to implement the methodology. If required, NEMMCO would forward this information to the relevant TNSP for the preparation of the connection point load forecasts.**

**If the TNSPs are unable to provide NEMMCO with appropriate connection point load forecasts the methodology includes provision for NEMMCO to calculate the forecasts using a simplified methodology.**

**7.4** Is the timing of the load forecasts correct?

**View of Interested Party**

**Powerlink considers that loss factors should apply for a financial year and acknowledges that NEMMCO is obliged to develop the methodology that applies loss factors for a financial year. Powerlink would want to have input to any future considerations of changing the time by which load forecasts are required in order to prevent duplication of effort.**

**On balance Powerlink considers it more appropriate for the load forecast cycle to be post winter with the forecast produced by end December each year. This would allow the forecast to be used for the annual planning review instead of a forecast that is 12 months old.**

**NEMMCO Consideration**

**Any changes to the NEMMCO methodology would need to be developed in accordance with the Code consultation procedures.**

**Any changes to the time over which loss factor apply would require Code changes and would be subject to consultation by NECA and the ACCC.**

**7.5** Are the TNSPs exposed to additional work and liabilities when providing the connection point load forecasts?

**View of Interested Party**

**TransGrid agrees that TNSPs would be in the best position to provide connection point forecast but considers this will represent significant additional work. TransGrid is also concerned with the possibility of exposing the TNSPs to additional liabilities in providing these forecasts. Therefore TransGrid supports the proposal that TNSPs should only provide the forecasts in good faith and not be held liable for the accuracy or use of such information. TransGrid proposes that NEMMCO considers resolving this matter under a separate process, and believes that resolution of this issue, prior to implementation of the methodology, is necessary to avoid any future dispute.**

**NEMMCO Consideration**

**The TNSPs are currently obliged to provide NEMMCO with regional energy and maximum demand forecasts for a 10 year outlook period. NEMMCO recognises that the provision of connection point forecasts involves additional work.**

**NEMMCO accepts that the connection point data is provided by the TNSPs in good faith. NEMMCO will perform due diligence on the data and consult with the relevant TNSP to resolve any errors detected in the data.**

## 7.6 Should the flow on MNSPs be unmodified from the historical flow?

**View of Interested Party**

**Powerlink supports the use of historic flows for existing MNSPs.**

**Stanwell disagrees with using unchanged MNSP flows for existing MNSPs as they believe it will distort the loss factor results, particularly in cases where there have been significant shifts in generation and or load. While Stanwell appreciates NEMMCO's arguments for their proposed approach and at present cannot suggest an alternative solution, they recommend NEMMCO undertake a further examination of the issue.**

**NEMMCO Consideration**

**NEMMCO considers that assuming zero flow for a MNSP would distort the loss factors for the MNSP and surrounding connection points. Similarly, a more complex methodology, such as market simulations, is more tractable but is not consistent with the principle of minimum extrapolation. Also, MNSPs often operate in response to random generator unit outages or in accordance with contract positions. Therefore, NEMMCO considers that historical MNSP flows should be used for calculating forward-looking loss factors.**

## 7.7 Should the flow on new MNSPs, including Basslink, be zero?

**View of Interested Party**

**Powerlink supports the use of zero flow for new MNSPs until history is established.**

**Edison Mission agrees that the assumed flow of new MNSP's should generally be zero. Edison Mission also agree that in the absence of better information the minimal extrapolation approach should be adopted, and therefore, Basslink flow should also be assumed to be zero. Any other assumption about Basslink was considered to be highly subjective and would most likely not reflect the actual operation.**

**Stanwell disagrees with assuming zero flow for new MNSPs as they can have a significant impact on local transmission network flows and resulting loss factors for associated connection points.**

**NEMMCO Consideration**

**As stated in section 7.6, it is not possible to accurately estimate MNSP flows so NEMMCO intends to use zero flow until sufficient history becomes available. Therefore, NEMMCO believes that assuming zero flow for a new MNSP is consistent with assuming historical flows for existing MNSPs and is therefore consistent with the principle of minimal extrapolation. NEMMCO considers that making any other assumptions could significantly distort the loss factors in the surrounding network.**

## 7.8 How should the dispatch of new generating units be determined?

**View of Interested Party**

**Hazelwood disagrees with the approach for determining the flow for new generating units. They do not believe that generating technology and fuel type are necessarily the major determinants for generator behaviour. Also, fuel costs are not readily available and cannot be assumed from historical information. In addition costs can be represented by a single number but vary significant over the operating range of the units and include components over than the fuel.**

**Stanwell supports the 'historical data' approach adopted by NEMMCO for estimating dispatch of new generating units following commissioning. However, they believe that it is not only important to identify units with a similar fuel type, but also similar fuel quality. Also, given the rapid pace of technological change in the industry, they believe that 10 years is too long. Finally, given the small number of generating units in the NEM (relative to other markets) it may not always be possible to identify a similar unit based on technology and fuel type. They suggest that consideration should also be given to the operation and performance of similar units outside the NEM.**

**NEMMCO Consideration**

**NEMMCO agrees that there is uncertainty with anticipating the exact behaviour of a new generating unit as the behaviour will depend many factors including the fuel type, cost and quality, the region and the bidding strategy employed by the unit's operator. Therefore, given this uncertainty, NEMMCO believes that the estimate of the dispatch of a new generating unit should be based on the aggregate dispatch of a number of generally similar generating units rather than attempting to find one or more identical units. For example, the dispatch of a new black coal generating unit would be estimated from all black coal generators in Queensland, New South Wales and South Australia that have been commissioned in the last say five years.**

**NEMMCO will refine the estimated dispatch of new generating units by confirming the general reasonableness of the initial estimates with the proponent.**

**Where NEMMCO and the proponent agree, NEMMCO will base the dispatch of new peaking generating units on the historical dispatch of peaking plants within the same region, rather than the whole NEM.**

**7.9** Should the energy used during commissioning be used estimated when calculating the loss factors?

**View of Interested Party**

**Stanwell is concerned that the methodology does not account for the energy that it supplied to the network prior to commissioning. As a commissioning unit can have a significant impact on transmission flows, Stanwell suggests that NEMMCO include, in the Methodology, a process for estimating the dispatch of a new generating unit during its commissioning period.**

**Further, Stanwell consider it is often difficult for plant operators to estimate the exact date of commissioning so far in advance. Consequently, Stanwell proposes that NEMMCO, for the purposes of estimating new generator dispatch, incorporate a margin around the specified commissioning date following consultation with the relevant parties.**

**NEMMCO Consideration**

**The Code requires loss factors to apply for one year so the commissioning date of a new generating unit will need to be estimated between six and 18 months in advance of the unit being commissioned. Consequently NEMMCO expects that there may be significant uncertainty in the commissioning dates of some units. Also, NEMMCO considers that it would be impracticable to precisely predict the generation pattern during commissioning, by trading interval.**

**However, NEMMCO considers that the exact commissioning date is unlikely to have a significant affect on the loss factor of a new unit as the loss factor is the volume weighted average over its period of operation that financial year. NEMMCO does acknowledge that changes to the commissioning date a new generating unit may affect the loss factors of other connection points in that vicinity but this is inevitable given the period of time between the loss factors being calculated and any new units being commissioned.**

**7.10** Should load shedding be at the regional reference node or distributed?

**View of Interested Party**

**Hazelwood considers that it is not appropriate to include fictitious generators to represent load shedding. While this may be the expedient adopted in analysis, it should not be part of the principles on which the analysis is based. Furthermore, if load shedding were significant to the analysis, then it should be recognised that it would be distributed between nodes and not occur solely at the regional reference node.**

**NEMMCO Consideration**

**NEMMCO anticipates that load shedding would generally not be required when calculating forward-looking loss factors. The connection point load forecasts are based on maximum demands derived from medium load growth and 50 % probability of exceedance (POE) weather conditions, while NEMMCO is using 10 % POE maximum demand forecasts in the Statement of Opportunities and MTPASA. NEMMCO believes this is a reasonable solution as it is only proposing the use of load shedding at the reference node as a last resort to restore the supply-demand balance.**

**NEMMCO agrees that it would be more accurate to distribute the load shedding throughout the affected regions but NEMMCO considers the added complexity is not warranted as load shedding in the calculation of loss factors is very unlikely and, in the event that it is required, the regional reference node is at the largest load centre. Also, the process of averaging loss factors over a financial year of data means that a short period of load shedding will not have a material impact on the loss factors.**

## 7.11 How should energy limited units be adjusted?

**View of Interested Party**

**Hazelwood considered that when energy limited generators are adjusted upward for one trading interval to restore the supply/demand balance, then there needs to be a downward adjustment at some other time in order to remain within the energy limit.**

**NEMMCO Consideration**

**NEMMCO agrees that theoretically it is appropriate to adjust downward the output of an energy limited plant at some other time in order to remain within the energy limit. However, NEMMCO considers that this is not consistent with the principle of minimum extrapolation, and accepts some minor level of inefficiency with minimal extrapolation if market simulations are not performed.**

**Further, NEMMCO anticipates that energy limited generating units are unlikely to be dispatched beyond their historical output for more than a few hours in a year and therefore will not have a significant impact on the energy limit of the generating units.**

## 7.12 How should the maximum available generator output be defined?

**View of Interested Party**

**Hazelwood considers that the generator capacity applied in the adjustment process is important in achieving a realistic result. The adjustment will be applied to the actual generation in an historical period, which was determined by the current capacity, and in order to give a reasonable outcome the capacity applied in the adjustment process should be this capacity that existed at that time. Otherwise unrealistic and inconsistent outcomes will result. Hazelwood believes these actual capacity values are readily available from NEMMCO's records.**

**Hazelwood consider there is a contradiction in NEMMCO's reason for proposing to use fixed capacity limits for the NEM generators. That is, NEMMCO indicated it was impractical to convert the availability between generator terminal and sent-out, while in another paragraph NEMMCO had indicated such conversion was required.**

**Powerlink considers it is most appropriate to use the maximum output values for generation specified in the SOO and to estimate the auxiliary load from the EMS and settlement data.**

**NEMMCO Consideration**

**NEMMCO's records do not include the sent out capacity of the NEM generating units, rather they include the generator terminal availability. NEMMCO does propose to convert the summer and winter capacity in the latest SOO from generator terminal to sent out. NEMMCO believes that it is not practicable to perform this calculation for every unit and every trading interval as this would require an accurate estimate of the auxiliaries over the operating output range of each unit.**

**NEMMCO confirms that there is no hidden agenda. Rather, NEMMCO is aiming for a robust methodology. NEMMCO considers that the added complexity proposed by Hazelwood is not justified as the changes to generator dispatch from their historical levels are expected to be small given that load growth is only 2 or 3 % per year.**

**Further, NEMMCO believes that it is more appropriate to base the loss factor calculations on the typical maximum capacities available from the NEMMCO SOO, and used in the NEMMCO PASA processes. This approach is preferred over the historical availability that may have been reduced due to an unplanned partial forced outage that is unlikely to occur at that time in subsequent years. Using the declared generator availability by trading interval provides the generator with an incentive to declare an availability that is only marginally above their current output in an attempt to gain a better loss factor.**

**NEMMCO proposes to use the declared maximum availabilities used in the SOO, with separate values for summer and winter.**

**7.13** Should the data used for the calculation of the loss factor a connection point defined during the year be confined to one region?

**View of Interested Party**

**Hazelwood supports the proposal in the Draft Methodology for the calculation of the loss factor for a connection points defined after the loss factors are published in that the analysis should not be confined to one market region.**

**Similarly, Powerlink considers loss factors for connection points added during the financial year should use the data set from the whole of the NEM not the regional data set.**

**NEMMCO Consideration**

**NEMMCO agrees that loss factors for connection points added during the financial year should use the data set for the whole of the NEM not just the regional data set.**

**NEMMCO notes that Clause 3.6.2A(g) of the gazetted RIEMNS Stage 1 Code changes no longer includes this specific requirement on the data used to calculate the loss factor for a connection points defined after the loss factors have been published.**

**7.14** Should the process for scaling the output of generating units up and down be symmetrical?

**View of Interested Party**

**Hazelwood believes that the process for generation reduction and the process for generation increases should be symmetrical, and in both cases should be plausible in terms of market behaviour. They propose that for both increases and decreases the adjustments should be proportional to the differences between historical capacity and historical output. Under this proposal units that are offered to the market in such a way that their full capacity is utilised would not be adjusted up or down. Units that are offered in such a way that they are loaded well short of their capacity would have a significant share of both increases and decreases. Hazelwood believe that this process, unlike that proposed by NEMMCO, is broadly consistent with observed market behaviour.**

**NEMMCO Consideration**

**Under a symmetrical process for adjusting generator dispatch the output of base load generators would rarely be reduced, with the majority of the reduction being assigned to units that are operating well below their capacity.**

**The proposed process for adjusting generation downwards in proportion to the historical output spreads the reduction in output across a large number of generating units. Therefore, each individual generating unit would not be operated significantly below its minimum technical generation level. However, using a symmetrical adjustment process would mean that generating units that were operating well below their capacity would be reduced by a larger amount then the other units and it would be necessary to consider if minimum generation levels would need to be modelled. NEMMCO believes that the need to determine the minimum generation levels for each generating unit would introduce added complexity to the process of calculating the loss factors.**

**7.15** Should additional generation be primarily allocated to generating units with a low utilisation?

**View of Interested Party**

**Yallourn believe that the proposed scaling of historical generator data is potentially flawed, as generators will typically offer additional capacity into the market. This is high-price dependent because high cost auxiliary firing may be necessary to achieve the full capacity. They believe that assuming that the generation will increase in proportion to the offered spare will lead to overstating the generation increase for high capacity factor generators, and hence penalise such plant financially.**

**Yallourn believe that the methodology should be based on a principle of allocating the additional generation to low capacity utilisation plant (on half-hourly basis). Therefore, Yallourn propose that no additional generation would be assigned to plant with a capacity factor of 0.90 or greater.**

**NEMMCO Consideration**

**NEMMCO disagrees with Yallourn in that generally an increment in demand is not meet by a high cost low capacity utilisation plant until all operating low cost plants are near their maximum capacity. For example, an increment of demand in Victoria would very rarely be met by the Victorian OCGTs, as indicated by the fact that these units rarely operate. However, NEMMCO does acknowledge that at higher demands an increment of demand may be met by either a higher cost peaking generator or by a high cost price/quantity band of a base load generator.**

**NEMMCO considers that the proposed methodology does attempt to balance between always increasing the output of generating units with the alternative of dispatching all units, including peaking plant, for each trading interval where the generation needs to be increased. This balance is achieved by only increasing operating generating units up to their nominal summer or winter capacity, and not utilising any overload capability that may only be available for short periods at high prices.**

**NEMMCO also considers that not assigning additional generation to plant with a capacity factor of 0.90 or greater could be considered at arbitrary, therefore, NEMMCO would be reluctant to include it in the methodology.**

**7.16** Should generating units that were unavailable be dispatched as a last resort?

**View of Interested Party**

**Hazelwood considers that the adjustment of the historical generation values to include output on units that were not available is not supported except as a last resort to avoid a modelling outcome including load shedding. This should be last in the priority sequence of generation adjustments.**

**NEMMCO Consideration**

**NEMMCO agrees that the dispatch of generators that were unavailable should be a low priority. In the Draft Methodology the only actions that have a lower priority are the dispatch of energy-limited plant and load shedding. NEMMCO placed changing the dispatch of unavailable plant above energy-limited plant to avoid inter-temporal effects (see 7.11). NEMMCO also placed changing the dispatch of unavailable plant above load-shedding as unavailable plant may be able to made available if a supply shortage occurred, depending on whether the outage was planned or forced.**

**Given that most generating units make themselves available at periods of high demand, NEMMCO anticipates that when calculating loss factors there will not be a regular need to change the dispatch of unavailable plant or energy limited plant, or load shedding. Further, when an unavailable generator is dispatched the output will be relatively small and of a short duration. This will not cause a large impact on the volume weighed loss factor.**

**7.17** Should the treatment of forced outages be consistent with MTPASA?

**View of Interested Party**

**Stanwell does not understand why NEMMCO is not making use of the information contained in the Medium-Term Projected Assessment of System Adequacy (MTPASA) when considering generator outages.**

**NEMMCO Consideration**

**NEMMCO can see a number of problems with utilising the information contained in MTPASA when calculating forward-looking loss factors.**

- **MTPASA only includes planned outages and not forced outages.**
- **If an outage occurred in the historical data but not in MTPASA, then a methodology similar to that required for a new generator is required to fill in the missing data.**

- **MTPASA is primarily an outage coordination tool to ensure medium term reliability. A snapshot of machine availability in MTPASA does not necessarily reflect future outages, rather it represents an iteration of the medium term reliability problem and may not converge until the 7 day short term timeframe.**

**The alternative of relying on the historical data also has the advantage that is provides the correct amount of planned and forced outages in the long term.**

## 7.18 How should interconnector limits be treated?

**View of Interested Party**

**Powerlink does not agree with use of notional interconnector limits from the SOO. It is acknowledged that analysis on this basis is much easier than the alternative of implementing constraint equations. However, as the flow on regulated interconnectors will not be based on the previous year the resultant flow could be significantly different from that which occurred or would occur due to use of constraint equations. Powerlink considers it is appropriate to reflect the actual capability of the interconnectors in these calculations as losses will be directly related to the actual flows that occur. If simple limits are used then interconnector flows may be overstated which will result in additional losses and distortions to the resulting loss factors and loss factor equations.**

**NEMMCO Consideration**

**Normally when interconnector limits are materially reduced it is due to random forced outages in the transmission network. When the network is intact, the interconnector limits are generally closer to the values in the SOO. Generally the availability of transmission lines is very high. Therefore, NEMMCO considers that the use of detailed interconnector constraint equations is not appropriate.**

**NEMMCO proposes to implement systems that would allow the use of individual interconnector limits for each trading interval. NEMMCO intends to implement representative interconnector limits for summer and winter, and peak and off peak periods. NEMMCO will consult with the TNSPs when developing these representative limits.**

## 7.19 How should pump storage schemes be treated?

**View of Interested Party**

**Powerlink considers that if a scheduled pumped storage generator has a common MLF for both its scheduled generation and scheduled pumping load operating modes, there will be a very substantial distortion of locational signals and is at odds with the stated objective of approximating full nodal pricing.**

**Powerlink also requested that NEMMCO outline the methodology of how such a single MLF would be calculated. They consider that the normal mathematical approach would require either the load or generation mode to be assigned as negative values thereby invalidating the energy volume weighted calculation. This could result in a severely distorted MLF. To overcome this mathematically, NEMMCO would have to effectively calculate separate generation and pumping mode MLFs and then combine them by a method, which has not been specified.**

**NEMMCO Consideration**

**NEMMCO agrees that it is ideal to have separate loss factors for operation as a generator and a pump. NEMMCO will calculate separate loss factors for pumping and generating where separate connection points have been defined. However, if a single connection point is defined for a pump storage scheme NEMMCO will calculate a single loss factor taking into account the direction of the power transfers at the connection point. This issue is discussed further in section 4.10.2.**

## 7.20 Should generator loss factors always be calculated on a sent out basis?

**View of Interested Party**

**Powerlink believe that NEMMCO should consider whether a mandatory requirement to calculate loss factors on a sent out basis regardless of physical supply arrangements for auxiliaries should be included it the methodology. This would ensure consistent application of the methodology to all generators.**

**NEMMCO Consideration**

**NEMMCO considers that forward-looking loss factors should be calculated from estimates of the connection point energies, by trading interval. This means that the correct loss factor is calculate for each generator auxiliary supply arrangement.**

**7.21** How should multiple entities at the same busbar be treated?

**View of Interested Party**

**Powerlink believes that if two or more such loads on the same busbar have distinctively different load patterns, eg a railway load and a typical DNSP load mix, or a smelter and a typical DNSP load mix, then significant errors in locational signals may arise. Powerlink considers that the very minor effort to calculate separate MLFs is justified as separate revenue metering will already exist for the different loads. If two fairly similar or typical load mix DNSPs are connected to the same busbar then Powerlink agrees that the same MLF should be assigned.**

**NEMMCO Consideration**

**NEMMCO believes that each connection point should have a loss factor that based on the energy traded at that connection point. Therefore, for the case where multiple participants are connected at a connection point NEMMCO would calculate a single loss factor based on the aggregate energy traded. However, where separate connection points are defined for different participants connected to the same busbar NEMMCO would calculate separate loss factors.**

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**The extreme cases considered by Powerlink, for example the case of a smelter and a typical DNSP load mix or a railway load on the same connection point, do not occur in practice as these types of loads generally have separate connection points in the NEM.**

### 7.22 How should generators and loads that can switch between connection points be treated?

**In the NEM at present this issue is unique to the connection of Yallourn unit 1. This unit can either be connected to the 220 kV or 500 kV networks in the Victorian Latrobe Valley. The choice of connection point affects the loss factor for Yallourn unit 1, the remaining 220 kV connected Yallourn units and the remainder of the Latrobe Valley generating units. Therefore, NEMMCO has undertaken additional discussions on this issue with Yallourn, some of the Latrobe Valley generators and VENCorp. This section summarises the views of Yallourn.**

**View of Interested Party**

**Yallourn believes that the operators of a generator or load that can switch between connection points should be able to provide NEMMCO with a forecast of their anticipated switching arrangement for the year the loss factors apply, and NEMMCO should use this forecast for calculating forward looking loss factors. Specific information that is to be included in the process is the connection agreement (with respect to dispatch) and changed (and independently verifiable) operational circumstances. These should be verifiable by NEMMCO.**

**Yallourn proposed the following principles:**

(1) **The key principle is that the methodology must drive to increase economic efficiency and seek to minimise the errors between forecast and actual loss factors.**

(2) **Historical generation levels will be used unless changes to the operating regime can be established.**

(3) **The historical switching pattern will be used unless changes to the operating regime can be established.**

(4) **Changes to the operating regime should be verifiable by a third party.**

(5) **The impact of these changes will be made available to NEMMCO.**

(6) **There should be a mechanism to prevent participants exploiting the forward looking methodology to gain unfair advantage by continuously biasing their forecasts to reduce loss factors and then not operating in accord with the forecast.**

**The calculation of loss factors is based on financial years.**


**In financial year $Y_{n+1}$ NEMMCO will be calculating the loss factors that will apply for the $Y_{n+2}$ financial year. NEMMCO will forecast the flows in the network for the $Y_{n+2}$ financial year by extrapolating the load and generation data from the $Y_n$ financial year.**

**If the owner of the generator or load is not anticipating a substantial change to their operating regime then NEMMCO would use the historical connection information from the $Y_n$ financial year. Where the owner is anticipating a substantial change to their operating regime they would submit to NEMMCO:**

- **a case to substantiate the change to their operating regime;**
- **an assessment by a third party (for example the associated TNSP); and**
- **the anticipated connection arrangement by trading interval for the $Y_{n+2}$ financial year.**

**NEMMCO would perform due diligence on the proposed changes to the operating regime and then incorporate the modified connection information into the calculation of the loss factors for the $Y_{n+2}$ financial year.**

**In the $Y_{n+3}$ financial year, when the $Y_{n+2}$ financial year is complete and NEMMCO is calculating the $Y_{n+4}$ loss factors, NEMMCO would assess the accuracy of the forecast connection arrangement provided by the generator owner by calculating forecast error. The forecast error would be defined as the difference between the forecast and actual total time in each switching arrangement over the financial year and would expressed in days.**

**Where the forecast error is no more than 20 days then NEMMCO would continue to allow the owner to submit their estimate of their operating regime, while if the forecast error is greater than 20 days then NEMMCO would use historical data for subsequent loss factor calculations.**

**NEMMCO Consideration**

**NEMMCO considers that as far as possible participants that can switch between connection points should be treated consistently with other aspects of the forward-looking loss factor methodology such the principle of minimum extrapolation and the treatment of network augmentations.**

**Under the draft forward-looking loss factor methodology the principle of minimum extrapolation is applied when forecasting the output of individual generating units and is used to account for forced and planned outages. If minimum extrapolation is applied to the connection of Yallourn unit 1 then NEMMCO would assume the historical connection arrangements when calculating forward-looking loss factors.**

**However, under the draft methodology network augmentations are included in the network configuration on the advice of the relevant TNSP. If the connection of Yallourn unit 1 is treated in the same manner as a network augmentation then NEMMCO would obtain a profile for the connection of the unit from VENCorp.**

**NEMMCO considers that Yallourn unit 1 should be treated as follows:**

- **minimal extrapolation would apply to the energy injected at the connection point and to outages of the unit; and**
- **the connection should be treated as a network issue, with NEMMCO taking advice from VENCorp.**

**VENCorp would prepare the connection profile in consultation with Yallourn, taking into account network operational and security restrictions. The profile would also include future changes to the operation of the Victorian network.**

**NEMMCO considers this approach as reasonable as the connection point profile is provided to NEMMCO by VENCorp. VENCorp manages the connection of Yallourn unit 1 via their connection agreement but do not have an interest in the resulting loss factors.**

**7.23** Should loss factors apply for the year starting 1 October rather than 1 July?

**View of Interested Party**

**TransGrid believes that there is benefit in aligning loss factors with the financial year in that TNSPs will not need to duplicate the forecasting work. As already noted in NEMMCO's paper, TNSPs have previously submitted there is considerable effort in producing additional load forecasts. Further, some Generators and Market Customers also believe that there is benefit in aligning the provision of loss factors with each financial year. TransGrid believe it would be better to publish loss factors on 1 July and have them apply from 1 October each year.**

**NEMMCO Consideration**

**NEMMCO agrees that there are some benefits in aligning the connection point calculation of loss factors with the load forecasts performed by the TNSPs. However, NEMMCO considers that this is outside the scope of the methodology for calculating loss factors as changing the start of the financial year from 1 July to 1 October would require significant changes to the Code.**

**7.24** Do the calculated standard deviations decoupled from variations between the regional reference node and Murray, the TPRICE swing bus?

**View of Interested Party**

**In their Draft Methodology NEMMCO states that it will calculate intra-regional loss factors for each trading interval relative to Murray Power Station then divide by the loss factor of the relevant Regional Reference Node relative to Murray.**

**Powerlink requested that NEMMCO describe how the loss factor standard deviations are to be calculated under the draft methodology, as distinct from other methods such as rerunning the model with the various Regional Reference Nodes in turn as the overall NEM reference. NEMMCO should demonstrate that variations in loss factors between the Reference Nodes and Murray are effectively isolated from the stated standard deviations of derived intra-regional MLFs.**

**NEMMCO Consideration**

**The version of TPRICE used by NEMMCO calculates the standard deviation of the marginal loss factors using the following formula:**

$$\sigma = \sqrt{\left( \frac{N \sum_k \left( d_i^k \left( \alpha_i^k / \alpha_{rj}^k - MLF_i \right)^2 \right)}{(N-1) \sum_k d_i^k} \right)}$$

**where**

$N$ is the number of trading intervals (17520 or 17568 for a financial year that includes 29 February)

$\alpha_i^k$ is the MLF of node "i" with respect to the swing bus[14] for trading period "k"

$\alpha_{rj}^k$ is the MLF of the reference node for region "j" with respect to the swing bus for trading period "k"

$d_i^k$ is the demand for node "i" for trading period "k"

and $MLF_i$ is the static loss factor for node "i" which is in region "j" defined as

$$MLF_i = \frac{\sum_k \left( d_i^k (\alpha_i^k / \alpha_{rj}^k) \right)}{\sum_k d_i^k}$$

TPRICE calculates the $\alpha_i^k$ values for each node with respect to the defined swing bus. The loss factor of node "i" can be defined in terms of node "j" for each trading interval by taking the ratio of loss factors with respect to the swing bus.

$$MLF_{ij}^k = \alpha_i^k / \alpha_{rj}^k$$

Therefore the swing bus does not affect the resultant loss factors for a given set of load and generation data.

The selection of swing bus does have a small effect on the calculation of backward-looking loss factors as the swing bus absorbs the aggregate error in the connection point load and generator data and the network losses.

## 7.25 Should all associated data be published?

14 NEMMCO normally selects the Murray power station as the swing bus for TPrice simulations.

**View of Interested Party**

**Edison Mission consider that all data and the assumptions behind that data used in the calculation of forward-looking loss factors must be made available to participants and stakeholders by being published.**

**NEMMCO Consideration**

**Loss factors are calculated from the settlements data used in the NEMMO settlements process. This data is confidential and is not available to be released to third parties.**

**NEMMCO is prepared to allow the calculation of loss factors to be audited at the request of a specific participant. The auditing cost should be born by the participant requesting the audit.**

**NEMMCO will seek to have, and fund, an audit conducted on the first set of loss factors calculated under the new methodology.**

# 8 Appendix B: Transmission Load Connection Point Forecast Load Profile Scaling

## 8.1 Requirement for Forecast load Profiles

**For the determination of forward-looking transmission marginal loss factors it is necessary to provide new forecast half-hourly loading profiles for each load connection point.**

**As outlined in section 3.2.45.2.4, where a half-hourly loading profile is not supplied by the relevant TNSP then AEMO will use the following algorithm to generate the profile.**

## 8.2 Process for Providing Forecast Load Profiles

**The provision of forecast transmission connection point load profiles shall generally be in accordance with the following procedure.**

1. **The loading profile based on actual historical revenue metering for the recent twelve-month period shall be established as a starting point.**

2. **Where the information is available to AEMO, these historical profiles should be corrected:**

- **for any significant distortion which occurred due to extensive load transfers between different connection points;**

- **for any significant distortion which occurred due to a period of unsupplied load or managed load reduction for any reason; and**

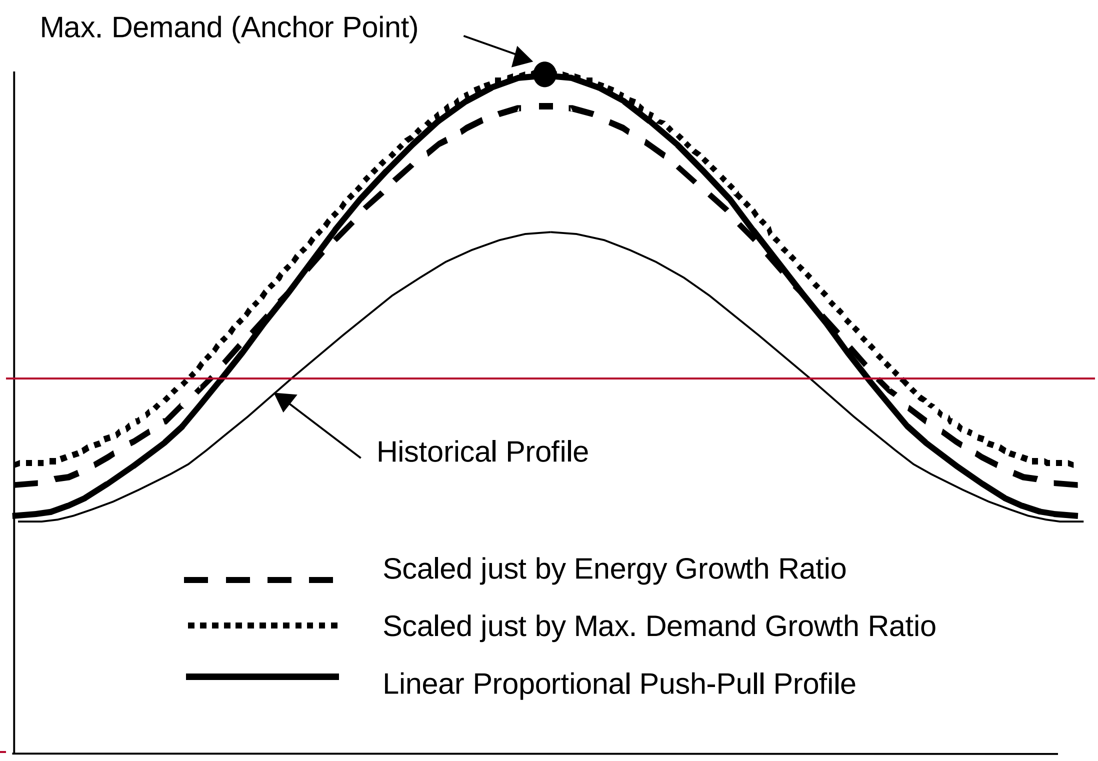
- **for significant distortion which occurred due to an atypical reduction in an embedded non-scheduled generator's dispatch.**

3. **The equivalent forecast energy, summer maximum demand and winter maximum demand growth rates between the timing of historical corrected data and the forecast year, shall then be applied to scale the profile, using the most appropriate scaling technique for the particular connection point.**

4. **For connection points where substantial committed change to the character and/or level of loading is expected, it could be more appropriate for an entirely new loading profile to be determined by agreement with the relevant network service provider or proponent of the change or both.**

## 8.3 Linear Proportional Push-Pull

**It is necessary to scale the energy and correct the peak demands by reallocating energy over all half hours according to the linear difference between each half hour's demand and the peak demand. A simplified illustration of this technique is shown below.**



**The method is equivalent to multiplying the entire profile by a ratio then adding or subtracting a fixed correction to each half hour. If the fixed correction amount is substantial, this algorithm can produce significant distortion of the profile at low loading levels.**

**Accordingly, this method may trim too much off low loading levels when creating peakier load shapes for large changes in demand and energy. It is generally well suited for creating flatter load profiles. However, for changes in demand of around 2-4% per year and energy changes of similar order, it is not expected that distortions will be significant or that they will have a material impact on the loss factor.**

# 9 Appendix C: Issues Raised from the Consultation on the Forward-looking Loss Factor Final Methodology

**On 7 May 2003 NEMMCO published version V01 of their final Forward-looking Loss Factor methodology. NEMMCO allowed a two-week period for further consultation on this version of the methodology. Submissions closed at 5:00pm on 26 May 2003.**

**NEMMCO received one submission from Yallourn Energy and this submission was published on the NEMMCO internet site. Yallourn Energy's submission raised the following three issues.**

## 9.1 Should "significant" be defined in section 5.5.5?

**Yallourn Energy's View**

**Section 5.5.5 of the methodology allows the switching profile of a switchable load or generator to be modified when the operator of the switchable load or generator considers the anticipated switching pattern for the year the loss factors will apply "differ significantly" from the historical switching pattern.**

**Yallourn Energy considers that the term "differ significantly" should be defined for clarity, and proposes a five day criterion.**

**NEMMCO Consideration**

**The intention of NEMMCO was that the operator of the switchable load or generator would, in consultation with the associated TNSP, decide whether the change in the switching pattern was significant. However, NEMMCO has included the suggested five-day criterion into the section 5.5.5 to improve the clarity of the methodology.**

## 9.2 Is the proposed scaling of historical generation data flawed?

**Yallourn Energy's View**

**Yallourn Energy consider that the proposed method for scaling up generation during periods of shortage, that is load growth is higher than the anticipated output of new generating units, is potentially flawed as it may be biased towards increasing the dispatch of base load generating units.**

**Yallourn Energy proposes that the additional output should be primarily allocated to low utilisation units.**

**NEMMCO Consideration**

**This issue was raised in Yallourn Energy's submission to the consultation on the Draft Methodology. This is discussed in section 7.15.**

**NEMMCO still considers that the method proposed by Yallourn is arbitrary, with the resulting dispatch dependent on the form of the proposed function f(ACF,CF).**

**It is unclear whether Yallourn energy would distinguish between generation units that are ON and OFF. If they do then the methodology proposed by NEMMCO does dispatch lightly loaded generating units more than fully loaded units. If Yallourn Energy don't distinguish between ON and OFF generating units then their proposal would dispatch available peaking plant, even at time of low demand.**

**Therefore, NEMMCO believes that the approach in this Methodology for increasing generation is a reasonable compromise, given the need for the methodology to be robust and indicative of the generation dispatch anticipated in the year loss factors apply.**

**9.3** Is the wording of the third dot point in section 5.5.2 correct?

**Yallourn Energy's View**

**Yallourn believes that the wording of the third dot point in section 5.5.2 should be changed to:**

**"the capacity of the non energy limited generating units that were not running (OFF) and is unavailable is not dispatched;"**

**NEMMCO Consideration**

**NEMMCO disagrees. Unavailable units will only be dispatched with a very low priority, that is, when all available units are fully dispatched. NEMMCO expects that this will only occur for a small portion of the trading intervals during the year the loss factors will apply.**

**NEMMCO has inserted the ramping back of scheduled pumps as an additional dot point in the dispatching priority in section 5.5.2. This means that unavailable generating units will now not be dispatched until all available plant (ON and OFF) is dispatched and all scheduled loads ramped back to zero load.**

## Appendix A: Forecasting the Generating Data for New Units Based on Information from the Proponents

This appendix [A3]contains a description of adescribes the process where the proponents of a new generating unit provides to NEMMCOAEMO the information necessary for NEMMCO to determine the forecast generating data. The process contains mechanism that are intended to ensureensures that the proponents provide NEMMCO with realistic information to AEMO. The process is:

- Each new generator is assumed to operate continuously at full load from its installation date, subject to AEMO receiving credible advice from the operator of reductions due to:
  - forced outages
  - planned outages
  - an energy limit
  - an intent to operate only when the relevant regional reference node price exceeds a stated value, or
  - generation being determined by factors outside the control of the participant such as the seasonal nature of the fuel source.
- No other grounds shall be accepted, and these restrictions shall be accepted only if NEMMCOAEMO, acting reasonably, accepts them as valid.
- Any specified reductions due to forced outage shall be incorporated as a uniform reduction in availability.
- Any specified reduction due to planned outage will be applied during periods specified by the participant.
- Any specified energy limit shall be applied by distributing generation from the highest price settlement period from the previous financial year to lower-priced periods until the specified energy is exhausted.

- Where an intent to operate only above a specified price is applied then the generation profile will comprise full-load when the corresponding historical price exceeded the specified value, and zero at other times.
- Where an external factor is limiting production, then the generation profile shall be as specified by the generator, provided this is accepted as reasonable by AEMO.

# Appendix B: Data Required by AEMO

The following table summarises the data necessary for AEMO to implement the forward-looking loss factor methodology. The table includes a description and the source of each item of data.

| Data | Description | Source |
|---|---|---|
| *Existing Load Connection Points* | | |
| Connection point load | MW & MVAr by trading interval | AEMO or relevant TNSP (AEMO will estimate the data if it is not supplied) |
| *New Load Connection Points* | | |
| Estimated commissioning date | Date of commercial operation | ESOO, confirmed with proponent |
| Connection point load | MW & MVAr by trading interval | AEMO or relevant TNSP |
| *Existing generating units* | | |
| Generator terminal capacity for summer and winter | Summer and winter MW values | ESOO |
| Auxiliary requirements for summer and winter | Summer and winter MW values | AEMO estimate with consultation with the registered owner |
| Historical generation profile | MW by trading interval | AEMO settlements data |
| Availability status by trading interval | Status by trading interval | AEMO market systems |
| *New generating units* | | |
| Estimated commissioning date | Date of commercial operation | ESOO, confirmed with the registered owner |
| Nameplate rating | MW | ESOO, confirmed with the registered owner |
| Similar units | List of generating units | AEMO discussions with the registered owner |
| Generation profile of similar units | MW by trading interval | AEMO settlements data |
| *Existing MNSP* | | |
| Historical energy transfer profile | MW by trading interval | AEMO settlements data |
| *New MNSP* | | |
| Estimated commissioning date | Date of commercial operation | ESOO, confirmed with proponent |
| *Interconnector Capability* | | |
| Capacity in each | MW by trading interval | ESOO, in consultation with the TNSPs |

| Data | Description | Source |
|---|---|---|
| *Existing transmission network* | | |
| Network data and configuration | Load flow, representative of system normal | AEMO EMS and operating procedures |
| *Transmission network augmentations* | | |
| List of network augmentations | List of augmentations | AEMO ESOO, in consultation with the TNSPs |
| Estimated commissioning date | Date of commercial operation | AEMO ESOO, in consultation with the relevant TNSP |
| Network element impedances | Network element impedances | Relevant TNSPs |