adani
renewables

27 November 2018

Mr. Christiaan Zuur
Director
Australian Energy Market Commission
PO BOX A2449
Sydney South NSW 1235

Dear Mr. Zuur,

RE: Request for changes to the National Electricity Rules to better accommodate Intra-Regional Settlement Residue Reallocation.

Adani Renewables requests, pursuant to section 92 of the National Electricity Law and section 8 of the Regulations, that the Commission make a change to Chapter 6 of the National Electricity Rules.

Adani Australia Renewables vision is to generate renewable energy as part of an energy mix that is reliable, secure and affordable for all customers. Adani is a world leading renewable energy business and in Australia, Adani Renewables is developing two utility scale solar facilities which will provides sustainable energy solutions to industry and the wider community.

Our first of two operations in Australia is the 65MW Rugby Run Solar Farm in Queensland, where construction is nearly complete and we are currently commissioning. Secondly we have the 132MW Whyalla Solar Farm in South Australia, where we are in advanced stages of development.

The existing rules regarding marginal loss factors (MLF) have been identified by many market participants including ourselves, as being outdated and not fit for purpose. The current rules are resulting in high inaccuracies and hence are distorting the market though inefficiencies in operational and investment decision making. Specifically the two components of the current MLF rule that have been found to cause these inefficiencies are:

1. Currently the generators do not receive any allocation of Intra-Regional Settlements Residue (IRSRs) that accrue due to MLF inaccuracies. IRSRs are returned only to one segment of market customers. A rule change to facilitate a reallocation of IRSRs to include generators will harbour savings that can be passed on to all market customers.

2. The inaccuracy in forecasting MLF for the following year/s results in generators assuming an artificially increased bid price as a result of an incorrect MLF. Hence generators are subject to an increased risk of not being dispatched, resulting in an increased cost of generation for all market customers.

Adani Renewables proposes a rule change that the allocation of IRSRs should apply equally to both generators and network users who are subject to non-locational prescribed TUOS charges. The result of this rule change will be an improved effective MLF (less losses) for generators that have been subject to inaccuracies and therefore more competitive generation bidding, resulting in lower prices to market customers.

Should you have any questions regarding any of the points discussed throughout this proposal, please feel free to contact Derek Chapman on derek.chapman@adani.com.au.

Yours sincerely,

Derek Chapman
Senior Commercial and Marketing Manager

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Intra-Regional Settlement Residue Reallocation

Rule Change Request

December 2018

Contents

1.0 Executive Summary

Marginal Loss Factors (MLFs) are currently presented in forward looking estimates for the following year, representing the change in network losses that occur due to a small increase in load at connection points across the NEM, compared to the change that would occur if the loads were located at the RRN. MLF is a significant factor in the investment decision of new generators entering the market. The difference between the forecast MLF and actual MLF varies significantly with variable generation and consumption within a region, with the excess revenue or Intra-Regional Settlement Residue (IRSR) as it is known, being distributed in accordance with the National Electricity Rules.

The IRSR is a representation of the cumulative error between actual marginal loss factors and forecast losses, with this error arising through generation patterns from year to year and forecasting errors. Currently the IRSR is collected by the Transmission Network Service Providers (TNSPs), which then allocate the IRSR as a credit to the non-locational Transmission Use of System (TUOS). This process is postage-stamped across all prescribed service customers but does not include generators. The IRSR has been a significant and growing amount over the past few years, highlighting inaccuracy due to the current MLF process.

For example Powerlink the Queensland TNSP, noted in their 2016/17 annual report that a key contributor to their higher cash position and EBIT performance was due to higher than forecast revenue collections through IRSR, totalling $115 million in 2016/17, an increase from $55 million on collections in 2015/2016.

Generators with inaccurate MLFs are impacted by the current rule as they end up with higher effective bid prices as a result of the inaccurate MLF and potentially will not be dispatched. This results in a higher priced generation being dispatched and this impacts all customers and contravenes the efficient investment, operation and use of electricity services for the long-term interests of electricity consumers and therefore the National Electricity Objectives (NEO).

Adani Renewables proposes a rule change so that the process for the allocation of IRSRs be revised to include generation connection points and not only the network users who are subject to non-locational prescribed TUOS charges. The result of this rule change will be lower effective MLFs for generators that have been subject to inaccuracies and therefore more competitive generation bidding, resulting in lower prices to market customers.

2.0 Name and address of rule change proponent

Adani Renewables

Level 25

10 Eagle Street

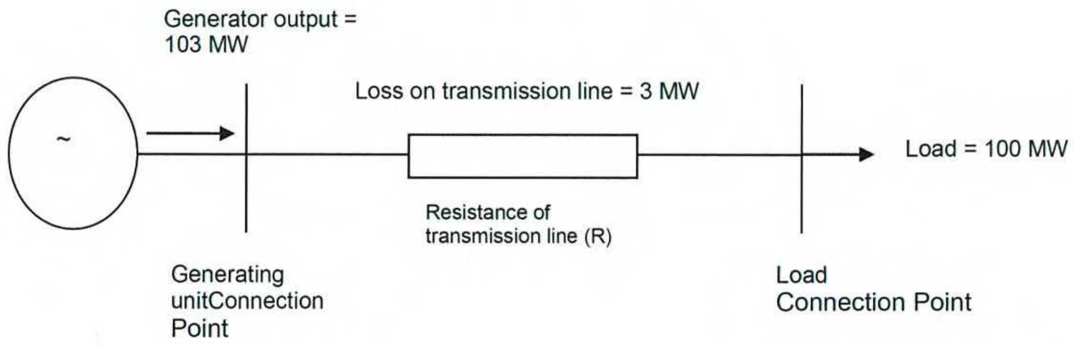
Brisbane

QLD 4000

3.0 Background

Within each region static Marginal Loss Factors (MLFs) are calculated to approximately represent the impact of marginal network losses on nodal prices at the transmission network connection points at which generation and loads are located. These static marginal loss factors are average values forecasted based upon historical network flow data from the previous financial year.

No transmission element is a perfect conductor of electricity. Because of resistance within the element, an amount of electricity is "lost" when being transported from one point to another. For example in the radial network shown below the generating unit must produce 103 MW of power to supply the 100 MW of load plus 3 MW of losses in the transmission line.



The spot price at a particular location within a region is calculated by multiplying the spot price at the RRN for that region by the appropriate transmission loss factor and (if relevant) the appropriate distribution loss factor.

Intended Purpose

MLFs were introduced into the NEM to provide:

- For the dispatch of generation that is as economically efficient as possible. The use of MLFs ensures that the network loss impacts on economic efficiency associated with loading alternative generation are properly incorporated into dispatch decisions.
- Efficient spot pricing signals for loads. This is important in allowing loads to participate in decisions about whether they are prepared to have their demand reduced rather than paying the occasionally high prices that may arise in the spot market.
- What is often referred to as "locational signalling" to existing Market Participants and new entrants.
- Ensure market neutrality between locations and participants.

MLFs are used to represent the change in network losses that occur due to a small increase in load at connection points across the NEM, compared to the change that would occur if the loads were located at the RRN. Conceptually, this can be achieved by modelling a small increase in load at each generation and load connection point in each region in turn, and determining the resultant increase in generation required to meet that load increase assuming it is supplied from a generating unit located at the RRN.

MLF is therefore a very significant factor in the determining the revenue of both existing and new generators entering the market. As such, it is important that the MLF are accurate (reflect real losses in the network) to provide an accurate signal for the optimal and efficient location of new generation. The accuracy of this signal also influences the efficiency of generator operational decisions, as it directly impacts the generator's position within dispatch.

Calculation of Forward-Looking Loss Factors (FFLF)

Prior to 2003, MLF's were calculated on a historical network flows. In April 2002, NEMMCO prepared and published a forward looking loss factors (FLLF) Issues Paper. The Final Methodology (V-02) was published on 12 August 2003. An algorithm for the calculation of FLLFs was then developed and implemented in the T-PRICE program.

The FLLF methodology relies on historical behaviour modified for known and likely new loads and connections. AEMO collects the historical profiles of generation and demand for the most recent full financial year. This data set is then extrapolated to meet the most up-to-date peak demand and energy projections for the next year. There are detailed clauses in the procedure that outline how new entrant plant, retirements, inter-connectors, semi/non-scheduled generation and embedded generation should be treated.

At the end of the process a volume-weighted MLF for each generator and load is published in April for the coming financial year. Volume weighting differs from time weighting (average) as the final weighted MLF is based on all observed MLFs across the year weighted against the generation or load profile. Generally volume weighting by generation will cause the volume weighted MLF to be lower than the average MLF.

Settlements Residue due to Network Losses

Intra-regional settlement residues (IRSR) is the type of settlements residue that arises due to intra-regional losses of electrical energy within a region, as opposed to losses between regions. Intra-regional losses occur when electricity is transferred between the regional reference node (RRN) and transmission connection points in the same region. To account for these losses in the system, intra-regional marginal loss factors (MLFs) are used by AEMO when considering which generators to dispatch. MLFs are also used as a price multiplier to determine how much a customer owes to AEMO and how much AEMO pays to a generator, based on the market participant's location in the transmission network and the associated losses. It is the use of MLFs as a price multiplier that most commonly results in intra-RR.

MLFs for intra-regional losses are static numbers that apply for a whole financial year for every transmission connection point. [1]The static MLF for each connection point is calculated by averaging the marginal losses modelled for each 30 minute trading interval over a 12 month period. [2]This approach results in MLFs that generally over-account for the actual losses in the transmission system and lead to the total amount paid by customers being greater than the total amount due to be paid to generators (i.e. AEMO is due to receive a surplus for that billing period, which is known as 'a positive intra-regional settlements residue'). Where positive IRSR occurs, AEMO is required to pay the full IRSR amount to TNSPs who are then required to pass this on to customers as a reduction in transmission services fees.

[1] AEMO releases the static intra-regional loss factors for a following financial year by 1 April.

[2] In some cases there are dual MLFs for one connection point. There are also cases where a virtual transmission node is created where multiple connection points have an MLF involving the weighted average of loss factors for an adjacent group of transmission connection points within a single region.

While positive IRSR is more common than negative IRSR, negative IRSR occurs under particular circumstances in the NEM. Negative IRSR primarily occurs where there is a high spot price in combination with high temperatures and/or high load. [3]These circumstances lead to higher losses in the system than the MLFs account for, resulting in AEMO collecting less than what it owes generators in that billing period. This difference or 'residue' is the negative IRSR.

The IRSR can be thought of as the cumulative error that arises because actual losses on a system may be different to, including lower than, forecast losses. As noted above, this error can arise due to the fact that losses are estimated at the margin, however changes in generation patterns from year to year may also be relevant. For example a gas generator may generate less than what was predicted by the MLF methodology as a result of increased gas prices. This error also occurs because of forecasting errors, for example new solar farms commencing generation later than forecast as a result of construction delays. Under the current arrangements any positive IRSR is collected by the TNSP.

The Powerlink Annual Report 2016/17 notes that "A key contributor to the higher closing cash position and the EBIT performance was higher than forecast regulated revenue collections in 2016/17. This was due to the significant increase in Inter and Intra-Regional Settlements Residue (IRSRs) collections through the Australian Energy Market Operator (AEMO). IRSR proceeds totalled $115 million in 2016/17, an increase from $55 million on collections in 2015/16." Furthermore the total Queensland node IRSRs for 2017/18 was $82 million which indicate a pattern of inaccuracy and error and is becoming more material.

Once collected, the TNSP allocates the IRSR as a credit in determining the non-locational TUOS revenue requirement in the following year. Non-locational TUOS is postage-stamped across all prescribed service customers and does not include Generators. As such, the application of MLF's on the market dispatch typically penalises generators through a reduction in revenue, whereas the distribution of the IRSR rewards particular customers through a reduction in TUOS charges.

Identification of the issue with the current arrangement

1. The current approach to the calculation and application of MLFs gives rise to loss factors that are approximations of actuals.
2. To the extent that high IRSRs represent cumulative error between forecast and actual losses, efficient dispatch of generation is undermined (through changing dispatch order and interfering with investment signalling).
3. Where MLFs are inaccurate, they can give rise to IRSRs. The existing approach of allocating these residues to customers via postage stamp TUOS then worsens the impact of any inaccuracy in loss factors, by funnelling this money away from generators.
4. Were IRSRs handed back to generators, some of the distortionary impact would be reduced.

An improved alternative arrangement would distribute the IRSR to generators on the basis of an accounting methodology that attempted to correct for inaccuracies in dispatch as a result of the use of static MLF values.

Ideally MLF's would accurately reflect real losses in the network, therefore minimising the IRSR. In the event that an IRSR is accumulated, there may be an opportunity to distribute the IRSR to generators on the basis of the real historical losses to correct for any inaccuracies associated with

[3] Negative IRSR can also occur as a result of very high MLFs

the MLF's, and associated inefficiencies caused by these inaccuracies. While this change to the reallocation process will not directly address the cause of inefficiencies caused by inaccurate MLFs, it may go some way to reducing the impacts this inaccuracy has on the investment and operational efficiency of the NEM.

4.0 Description of current and proposed rule

AEMO must provide settlement of the billing and payment of amounts due in respect of Chapter 3 of the NER. The NER explicitly require that IRSRs be recovered or credited against TUOS charges that levied on transmission network users.

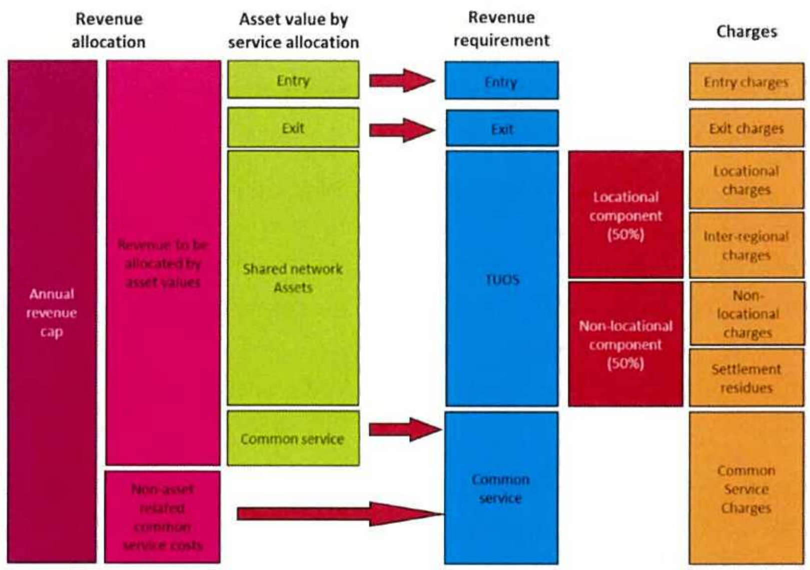
3.6.2 Intra-regional losses

(d) AEMO must determine, publish and maintain, in accordance with Rules consultation procedures, a methodology for the determination of intra-regional loss factors to apply for a financial year for each transmission network connection point.

Chapter 6A of the NER sets out the pricing methodology for transmission charges, and specifically accounts for settlements residues as part of transmission use of system charges levied on network users. Clause 6A.23.3 provides details for the allocation of the annual service revenue requirement to connection points and specifies that settlements residue arising from intra-regional loss factors are to be recovered or credited as part of the non-locational component of prescribed TUOS services.

6A.23.3(c) If the adjusted locational component is a positive amount, it is to be allocated to transmission network connection points of Transmission Customers on the basis of their proportionate use of the relevant transmission system assets. The CRNP methodology and the modified CRNP methodology are two permitted methodologies to estimate the proportionate use of the relevant transmission system assets as referred to in paragraph (b).

The rule change proposal is that the allocation of IRSRs should be shared equally between customers and generators. For generators, the distribution of half of the IRSR total would be prorated on the basis of the difference between the projected MLF and real losses once known at the end of each year.



A four step process to determine transmission prices

Figure: Australian Energy Regulator – 4 step process to determine transmission prices inclusive of settlement residues https://www.aer.gov.au/system/files/TN-Transmission%20Pricing%20Fact%20Sheet.pdf

5.0 The principles underpinning the rule change

The proposed rule change complies with the National Electricity Objective (NEO).

The NEO states that:

"the objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:

(a) price, quality, safety, reliability, and security of supply of electricity; and

(b) the reliability, safety and security of the national electricity system."

By increasing both generation investment efficiency and generation operational efficiency, the proposed rule change will satisfy the NEO.

To the extent that high IRSRs represent cumulative error between marginal and average transmission system losses, efficient dispatch of generation is undermined. That is a generator with an artificially increased bid price as a result of an inflated and incorrect MLF will not be dispatched. The resulting cost of dispatching a higher priced generator affects all customers, and contravenes the intention of the NEO. The proposed "wash up" between MLF and actuals losses at the end of each year would help this issue.

The current system whereby a generator with an artificially low MLF due to forecast error has its revenue and dispatch time reduced, works in opposition to micro economic competitive market fundamentals. By allowing generators to participate equally in the redistribution of the IRSR, the electricity market will exhibit behaviour closer to that of a competitive market. That is, by having greater generation (an increase in the supply curve) competition and inelastic customer demand (same demand curve), lower price outcomes for customers will result.

5.1 Increasing generation investment efficiency

The dual MLF rule change process identified the following issues associated with the accuracy of MLFs. Extract from the dual MLF RC issues paper states the following:

- As MLFs are used to refer Generator offers and Load bids to the RRN, an inaccurate static MLF may result in an inefficient dispatch process;
- Inaccurate MLFs and subsequent inefficient dispatch processes may result in:
  - the over or under recovery of IRR, with inefficient price outcomes for customers;
  - inefficient operational decisions by participants; and
  - inaccurate locational signals, which may result in inefficient investment decisions by participants.

Currently there is a lack of transparency in the NER in regards to the exact methodology by which the IRSRs are redistributed to the network users who pay non-locational TUOS. Although the methodology for the process of distribution of settlement residue is disclosed under 6A.23.3 of NER, there is a lack of disclosure of the specific parties affected and the process that this gain involves. By enabling generators to access IRSRs, this will give new and existing generation financiers and investors' confidence that inaccurate FLLF calculation impacts will be returned to generators and not simply be transferred to other market participants. Ideally MLF's would accurately reflect real losses in the network, therefore minimising the IRSR. In the event that an IRSR is accumulated, there should be an opportunity to distribute the IRSR to generators on the basis of the real historical losses to correct for any inaccuracies associated with the MLF's and this should facilitate efficient investment in new generation.

5.2 Increasing generation operational efficiency

The new process for reallocating IRSRs could be through application of an expected IRSR adjusted MLF. With greater transparency of expected revenue generators will be able to apply a corrected MLF that will then be reflected in the generator bid price at the RRN node for dispatch. As the generator will now have an improved MLF, the generator will be dispatched more frequently allowing economic dispatch closer to the optimal to occur and therefore lower prices will be the result.

6.0 Consequences of the proposed rule change

6.1 TNSP's

This group will have to administer the reallocation of IRSR to include generators. Currently, TNSP's are gaining from these IRSRs as a benefit to cash flow. Consequently, if this rule change were to occur, the TNSP's would be affected by reduced cash flows.

6.2 Network users who are subject to non-locational prescribed TUOS charges

Network users will see a smaller credit to their non-locational prescribed TUOS charges on an annual basis however only TNSP's will be able to confirm the magnitude of this impact. This group may include large customers who currently receive the benefit of a settlement residue. Although this group may be subject to a smaller share of the IRSR and may face increased bills, this group will also then benefit through reduced wholesale prices as generators who benefit from this rule change will subsequently be able to bid in at lower prices, thus the added benefits of lower electricity prices will more than offset the reduction in IRSR.

6.3 AEMO

This group will be impacted by needing to develop a new MLF methodology. They will also potentially be required to upgrade the T-PRICE or equivalent software.

6.4 Generators

This group will now have greater revenue from the same fixed cost base and which will reduce the market price of generation. Operational benefits will flow on therefore in the form of a reduction in generator bids and wholesale prices. Benefits will not only help existing generators, but also help facilitate future investment of new generators into the market. Investment benefits that will result are by providing investors greater certainty (reduced risk) leading to lower capital return expectations (both debt and equity). This will help drive supply increases, thus reducing costs for the customers. As such, by including generators in the settlement residue refund process, a wider benefit is felt throughout the NEM market, benefiting both generators and customers.

6.5 Customers

This group will receive lower generation prices. By allowing generators to participate equally in the redistribution of the IRSR, the electricity market behaviour will be closer to that of a competitive market meaning by having greater generation (increase in supply curve) competition and inelastic customer demand (same demand curve), lower price outcomes for customers will result. This customer group includes residential and C&I customer segments. Currently this stakeholder group doesn't benefit at all from the settlement residue refund, so by including generators into the IRSR refund process, a wider economic gain will be felt by all users of the market. This goes on to support the NEO principles of promoting efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity.

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5th February 2019

Mr. Christiaan Zuur
Director
Australian Energy Market Commission
PO BOX A2449
Sydney South NSW 1235

Dear Mr. Zuur,

RE: Request for changes to the National Electricity Rules from marginal loss factor methodology to average loss factor methodology

Adani Renewables requests, pursuant to section 92 of the National Electricity Law and section 8 of the Regulations, that the Commission make a change to Chapter 6 of the National Electricity Rules.

Adani Australia Renewables vision is to generate renewable energy as part of an energy mix that is reliable, secure and affordable for all customers. Adani is a world leading renewable energy business. In Australia, Adani Renewables is developing two utility scale solar facilities which will provide sustainable energy solutions to industry and the wider community.

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The existing rules regarding marginal loss factors (MLF) have been identified by many market participants (including ourselves) as being outdated and not fit for purpose. The current rules are resulting in high inaccuracies and hence, distort the market though inefficiencies in operational and investment decision making. Specifically the two components of the current MLF rule that have been found to cause these inefficiencies are:

1. Generators currently do not receive any allocation of Intra-Regional Settlements Residue (IRSRs) that accrue due to MLF inaccuracies. IRSRs are returned only to one segment of market customers. A rule change to use average loss factors rather than MLFs, equally applied to generators and customers will provide savings to the entire market.

2. The inaccuracy in forecasting MLF for the following year/s results in generators assuming an artificially increased bid price as a result of an incorrect MLF. Hence generators are subject to an increased risk of not being dispatched, resulting in an increased cost of generation to all market customers.

Adani Renewables proposes a rule change that the MLF calculation methodology should be changed to be an average loss factor. The result of this rule change will be less losses for generators and

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customers and a more accurate reflection of the cost of generation. This will facilitate more competitive generation bidding and will result in lower prices received by all market customers.

Should you have any questions regarding any of the points discussed throughout this proposal, please feel free to contact Derek Chapman on derek.chapman@adani.com.au.

Yours sincerely,

Derek Chapman
Business Manager - Adani Renewables

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Average Transmission Loss Factor

Rule Change Request

February 2018

Contents

1.0 Executive Summary

Marginal Loss Factors (MLFs) are currently presented in forward looking estimates for the following year, representing the change in network losses that occur due to a small increase in load at connection points across the NEM, compared to the change that would occur if the loads were located at the RRN. MLF is a significant factor in the investment decision of new generators entering the market. The difference between the forecast MLF and actual losses will vary significantly due to variable generation and consumption within a region, with the excess revenue or Intra-Regional Settlement Residue (IRSR) as it is known, being distributed in accordance with the National Electricity Rules.

The IRSR is a representation of the cumulative error between forecast marginal loss factors and average losses, with this error arising through generation patterns from year to year and forecasting errors. Currently the IRSR is collected by the Transmission Network Service Providers (TNSPs), which then allocate the IRSR as a credit to the non-locational Transmission Use of System (TUOS). This process is postage-stamped across all prescribed service customers but does not include generators. The IRSR has been a significant and growing amount over past few years in some regions, highlighting inaccuracy due to the current MLF process.

For example Powerlink the Queensland TNSP, noted in their 2016/17 annual report that a key contributor to their higher cash position and EBIT performance was due to higher than forecast revenue collections through IRSR, totalling $115 million in 2016/17, an increase from $55 million on collections in 2015/2016.

Generators with inaccurate MLFs are impacted by the current rule as they end up with higher effective bid prices as a result of the inaccurate MLF and potentially will not be dispatched. This results in higher cost generation being dispatched which impacts all customers and contravenes the efficient investment, operation and use of electricity services for the long-term interests of electricity consumers and therefore the National Electricity Objectives (NEO).

On the 7th of December 2018, Adani Renewables proposed a rule change so that the process for the allocation of IRSRs be revised to include generation connection points and not only the network users who are subject to non-locational prescribed TUOS charges. The result of this rule change will be lower effective MLFs for generators that have been subject to inaccuracies and therefore more competitive generation bidding, resulting in lower prices to market customers. This rule change to move from MLFs (with IRSR reallocation to include generation) to an average loss factor methodology will be a further improvement as average loss factors can be calculated at the commencement of each year (rather than a wash up of IRSRs in arrears).

2.0 Name and address of rule change proponent

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3.0 Background

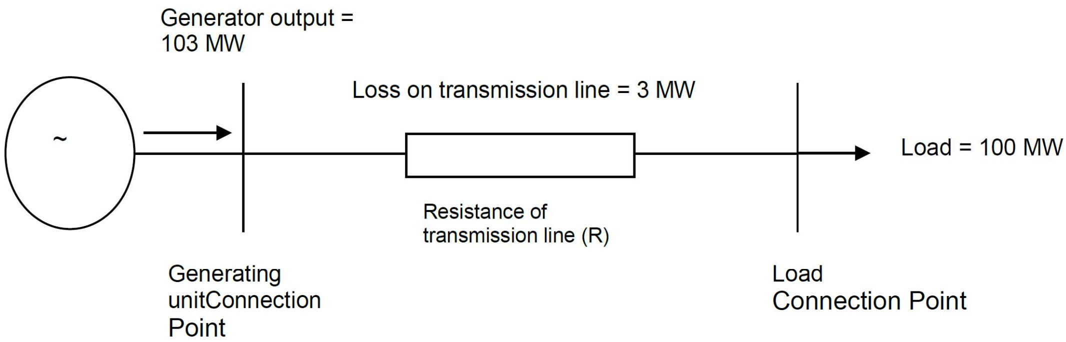
Transmission Losses occur due to the physical properties of electricity transmission systems, principally resistance. Two sources of losses occur in transmission systems being fixed and variable.

Fixed losses occur within the iron cores of transformers, cables and overhead lines whenever the circuit is energised. The magnitude of these losses is not dependent on the magnitude of the current being carried by the conductor but rather the magnetic field created by the applied voltage and the induced currents this creates within the iron core. As the voltage is more or less constant, these losses are also considered non-varying.

Variable losses are the losses which vary with the current carried by the conductor. These losses occur in cables, overhead lines and transformers and are dependent on the degree of resistive heating experienced. Losses in transmission systems are a function of the current carried by the conductors. The loss experienced in a conductor carrying alternating current is given by the equation I2R, where I is the current and R is the resistance of that conductor. This resistance causes energy to be absorbed by the conductor which results in the conductor heating up and this energy is lost to the surroundings. The resistance of an individual conductor is in turn a function of the materials used in its construction, how these are combined, and the length of the conductor. Multiple transmission system components can be considered as a single route with its own characteristics. In this way the route that energy fed in to the National Electricity Market (NEM) takes to reach the demand centres can be thought of as a very long conductor. As a longer length increases the overall resistance, and hence transmission losses, we can see that the location of generation infeed relative to demand will affect the level of transmission losses experienced.

Today within each region of the NEM, rather than calculate the actual transmission losses, static Marginal Loss Factors (MLFs) are calculated to approximately represent the impact of marginal network losses on nodal prices at the transmission network connection points at which generation and loads are located. These static MLFs are average values forecasted based upon historical network flow data from the previous financial year.

No transmission element is a perfect conductor of electricity due to losses. For example in the radial network shown below the generating unit must produce 103 MW of power to supply the 100 MW of load plus 3 MW of losses in the transmission line.



The spot price at a particular location within a region is calculated by multiplying the spot price at the RRN for that region by the appropriate MLF and (if relevant) the appropriate distribution loss factor (DLF).

Intended Purpose

MLFs were introduced into the NEM to provide:

- For the dispatch of generation that is as economically efficient as possible. The use of MLFs ensures that the network loss impacts on economic efficiency associated with loading alternative generation are properly incorporated into dispatch decisions.
- Efficient spot pricing signals for loads. This is important in allowing loads to participate in decisions about whether they are prepared to have their demand reduced rather than paying the occasionally high prices that may arise in the spot market.
- What is often referred to as “locational signalling” to existing Market Participants and new entrants.
- Ensure market neutrality between locations and participants.

MLFs are used to represent the change in network losses that occur due to a small increase in load at connection points across the NEM, compared to the change that would occur if the loads were located at the RRN. Conceptually, this can be achieved by modelling a small increase in load at each generation and load connection point in each region in turn, and determining the resultant increase in generation required to meet that load increase assuming it is supplied from a generating unit located at the RRN.

MLF is therefore a very significant factor in the determining the revenue of both existing and new generators entering the market. As such, it is important that the MLF are accurate (reflect real losses in the network) to provide an accurate signal for the optimal and efficient location of new generation. The accuracy of this signal also influences the efficiency of generator operational decisions, as it directly impacts the generator’s position within dispatch.

Calculation of Forward-Looking Loss Factors (FFLF)

Prior to 2003, MLF’s were calculated on a historical network flows. In April 2002, NEMMCO prepared and published a forward looking loss factors (FLLF) Issues Paper. The Final Methodology (V-02) was published on 12 August 2003. An algorithm for the calculation of FLLFs was then developed and implemented in the T-PRICE program.

The FLLF methodology relies on historical behaviour modified for known and likely new loads and connections. AEMO collects the historical profiles of generation and demand for the most recent full financial year. This data set is then extrapolated to meet the most up-to-date peak demand and energy projections for the next year. There are detailed clauses in the procedure that outline how new entrant plant, retirements, inter-connectors, semi/non-scheduled generation and embedded generation should be treated.

At the end of the process a volume-weighted MLF for each generator and load is published in April for the coming financial year. Volume weighting differs from time weighting (average) as the final weighted MLF is based on all observed MLFs across the year weighted against the generation or load profile. Generally volume weighting by generation will cause the volume weighted MLF to be lower than the average MLF.

Settlements Residue due to Network Losses

Intra-regional settlement residues (IRSR) is the type of settlements residue that arises due to intra-regional losses of electrical energy within a region, as opposed to losses between regions. Intra-regional losses occur when electricity is transferred between the regional reference node (RRN) and transmission connection points in the same region. To account for these losses in the system, intra-regional marginal loss factors (MLFs) are used by AEMO when considering which generators to dispatch. MLFs are also used as a price multiplier to determine how much a customer owes to AEMO and how much AEMO pays to a generator, based on the market participant's location in the transmission network and the associated losses. It is the use of MLFs as a price multiplier that most commonly results in intra-RR.

MLFs for intra-regional losses are static numbers that apply for a whole financial year for every transmission connection point. [1]The static MLF for each connection point is calculated by averaging the marginal losses modelled for each 30 minute trading interval over a 12 month period. [2]This approach results in MLFs that generally over-account for the actual losses in the transmission system and lead to the total amount paid by customers being greater than the total amount due to be paid to generators (i.e. AEMO is due to receive a surplus for that billing period, which is known as 'a positive intra-regional settlements residue'). Where positive IRSR occurs, AEMO is required to pay the full IRSR amount to TNSPs who are then required to pass this on to customers as a reduction in transmission services fees.

While positive IRSR is more common than negative IRSR, negative IRSR occurs under particular circumstances in the NEM. Negative IRSR primarily occurs where there is a high spot price in combination with high temperatures and/or high load. [3]These circumstances lead to higher losses in the system than the MLFs account for, resulting in AEMO collecting less than what it owes generators in that billing period. This difference or 'residue' is the negative IRSR.

The IRSR can be thought of as the cumulative error that arises because actual losses on a system may be different to, including lower than, forecast losses. As noted above, this error can arise due to the fact that losses are estimated at the margin, however changes in generation patterns from year to year may also be relevant. For example a gas generator may generate less than what was predicted by the MLF methodology as a result of increased gas prices. This error also occurs because of forecasting errors, for example new solar farms commencing generation later than forecast as a result of construction delays. Under the current arrangements any positive IRSR is collected by the TNSP.

The Powerlink Annual Report 2016/17 notes that “A key contributor to the higher closing cash position and the EBIT performance was higher than forecast regulated revenue collections in 2016/17. This was due to the significant increase in Inter and Intra-Regional Settlements Residue (IRSRs) collections through the Australian Energy Market Operator (AEMO). IRSR proceeds totalled $115 million in 2016/17, an increase from $55 million on collections in 2015/16.” Furthermore the total Queensland node IRSRs for 2017/18 was $82 million which indicate a pattern of inaccuracy and error and is becoming more material.

Once collected, the TNSP allocates the IRSR as a credit in determining the non-locational TUOS revenue requirement in the following year. Non-locational TUOS is postage-stamped across all

[1] AEMO releases the static intra-regional loss factors for a following financial year by 1 April.

[2] In some cases there are dual MLFs for one connection point. There are also cases where a virtual transmission node is created where multiple connection points have an MLF involving the weighted average of loss factors for an adjacent group of transmission connection points within a single region.

[3] Negative IRSR can also occur as a result of very high MLFs

prescribed service customers and does not include Generators. As such, the application of MLF's on the market dispatch typically penalises generators through a reduction in revenue, whereas the distribution of the IRSR rewards particular customers through a reduction in TUOS charges.

Identification of the issue with the current MLF arrangement

1. The current approach to the calculation and application of MLFs gives rise to loss factors that are approximations of actuals.
2. Ignoring accurate pricing for transmission losses may result in a significant distortion of the true cost of transmission.
3. This in turn results in transmission and generation investment decisions that are less than optimal.
4. Were average or real time (accurate) losses used and not forecast MLFs, the distortionary impact would be eliminated.

From an economic efficiency perspective, marginal cost pricing for losses results in the most efficient dispatch, since each generator will see a price for losses that exactly reflects the incremental cost of transmission arising from their contribution to power flows. This result is consistent with pricing in a competitive market, where the market price is equal to the marginal cost of the last supplier needed to meet demand (Marginal Cost Pricing).

With Marginal Cost Pricing, transmission losses are priced according to MLFs with the MLF at a connection representing the percentage increase in system losses caused by a small increase in power injection or withdrawal at the connection. By formula, Marginal Cost Pricing methods (using MLFs) are equal to twice the real average loss factors. This means there is always an over-collection of loss revenues (leading to high IRSRs). By applying a scaling down MLFs by a constant shift factor (averaging), the over-collection of lost revenues (IRSRs) would not occur and the correct incentive for efficient generation would be preserved.

In the event that an IRSR is accumulated prior or during to a change to average loss factors, there may be an opportunity to distribute the IRSR to generators on the basis of the real historical losses corrected for any inaccuracies associated with MLF's, and associated inefficiencies caused by these inaccuracies. While this change to the loss factor methodology is not perfect (being an annual average rather than 5 minute real time), it will go a long way in reducing the impact current inaccuracies have on the investment and operational efficiency of the NEM and is relatively simple to introduce.

4.0 Description of current and proposed rule

AEMO must provide settlement of the billing and payment of amounts due in respect of Chapter 3 of the NER. The NER explicitly require that IRSRs be recovered or credited against TUOS charges that levied on transmission network users.

3.6.2 Intra-regional losses

(d) AEMO must determine, publish and maintain, in accordance with Rules consultation procedures, a methodology for the determination of intra-regional loss factors to apply for a financial year for each transmission network connection point.

Chapter 6A of the NER sets out the pricing methodology for transmission charges, and specifically accounts Intra-regional losses.

3.6.2 Intra-regional losses

(a) Intra-regional losses are electrical energy losses that occur due to the transfer of electricity between a regional reference node and transmission network connection points in the same region.

(b) Intra-regional loss factors:

(1) notionally describe the marginal electrical energy losses for electricity transmitted between a regional reference node and a transmission network connection point in the same region for a defined time period and associated set of operating conditions;

(2) will be either:

(i) two intra-regional loss factors where AEMO determines, in accordance with the methodology determined under clause 3.6.2(d), that one intra-regional loss factor does not, as closely as is reasonably practicable, describe the average of the marginal electrical energy losses for electricity transmitted between a transmission network connection point and the regional reference node for the active energy generation and consumption at that transmission network connection point; or

(ii) one static intra-regional loss factor in all other circumstances;

(2A) must be determined in accordance with the methodology determined by AEMO under clause 3.6.2(d) for each transmission network connection point;

(d) AEMO must determine, publish and maintain, in accordance with Rules consultation procedures, a methodology for the determination of intra-regional loss factors to apply for a financial year for each transmission network connection point.

The rule change proposal is that

- AEMO must determine the Intra-regional loss factors Marginal Loss Factors according to the average loss factor methodology.

This calculation will as reasonably practicable, describe the average of the marginal electrical energy losses for electricity transmitted between a transmission network connection point and the regional reference node for the active energy generation and consumption at that transmission network connection point and little or no IRSR.

5.0 The principles underpinning the rule change

The proposed rule change complies with the National Electricity Objective (NEO).

The NEO states that:

"the objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:

(a) price, quality, safety, reliability, and security of supply of electricity; and

(b) the reliability, safety and security of the national electricity system."

By increasing both generation investment efficiency and generation operational efficiency, the proposed rule change will satisfy the NEO.

To the extent that high IRSRs represent cumulative error between marginal and average transmission system losses, efficient dispatch of generation is undermined. That is a generator with an artificially increased bid price as a result of an inflated and incorrect MLF will not be dispatched. The resulting cost of dispatching a higher priced generator affects all customers, and contravenes the intention of the NEO. The proposed average loss factor methodology would help this issue.

The current system whereby a generator with an artificially low MLF due to forecast error has its revenue and dispatch time reduced, works in opposition to micro economic competitive market fundamentals. By change the rule to use an average loss factor, the electricity market will exhibit behaviour closer to that of a competitive market. That is, by having greater generation (an increase in the supply curve) competition and inelastic customer demand (same demand curve), lower price outcomes for customers will result.

5.1 Increasing generation investment efficiency

The dual MLF rule change process identified the following issues associated with the accuracy of MLFs. Extract from the dual MLF RC issues paper states the following:

- As MLFs are used to refer Generator offers and Load bids to the RRN, an inaccurate static MLF may result in an inefficient dispatch process;
- Inaccurate MLFs and subsequent inefficient dispatch processes may result in:
  - the over or under recovery of IRR, with inefficient price outcomes for customers;
  - inefficient operational decisions by participants; and
  - inaccurate locational signals, which may result in inefficient investment decisions by participants.

Currently there is a lack of transparency in the NER in regards to the exact methodology by which the IRSRs are redistributed to the network users who pay non-locational TUOS. Although the methodology for the process of distribution of settlement residue is disclosed under 6A.23.3 of NER, there is a lack of disclosure of the specific parties affected and the process that this gain involves. By providing generators more accurate loss factors, this will give new and existing generation financiers and investors' confidence and result in more generation supply. Ideally loss factors would accurately reflect real losses in the network on a real time basis (or 5 minute), therefore allowing true least cost generation to out compete higher cost generation. This may be a further loss factor rule change improvement and opportunity over the coming years. Any reduction in inaccuracies associated with MLF's will ultimately facilitate efficient investment in new generation.

5.2 Increasing generation operational efficiency

With greater accuracy of expected revenue, generators can bid more aggressively into the dispatch market. As some generators will now have an improved loss factor, the economic dispatch order of generators will change and true economic dispatch will occur with greater frequently and therefore lower prices will be the result.

6.0 Consequences of the proposed rule change

6.1 TNSP's

This group will have to administer the application of the average MLF. Currently, TNSP's are gaining from IRSRs as a benefit to cash flow. Consequently, if this rule change were to occur, the TNSP's would be affected by reduced cash flows.

6.2 Network users who are subject to non-locational prescribed TUOS charges

Network users will see a smaller credit to their non-locational prescribed TUOS charges on an annual basis however only TNSP's will be able to confirm the magnitude of this impact. This group may include large customers who currently receive the benefit of a settlement residue. Although this group may be subject to a smaller share of the IRSR and may face increased bills, this group will also then benefit through reduced wholesale prices as generators who benefit from this rule change will subsequently be able to bid in at lower prices, plus the added benefits of lower electricity prices (as customers pay prices subject to losses) which will more than offset the reduction in IRSR.

6.3 AEMO

This group will be impacted by needing to develop a new MLF methodology. They will also potentially be required to upgrade the T-PRICE or equivalent software.

6.4 Generators

This group will now have greater revenue from the same fixed cost base and which will reduce the market price of generation. Operational benefits will flow on therefore in the form of a reduction in generator bids and wholesale prices. Benefits will not only help existing generators, but also help facilitate future investment of new generators into the market. Investment benefits that will result are by providing investors greater certainty (reduced risk) leading to lower capital return expectations (both debt and equity). This will help drive supply increases, thus reducing costs for the customers. As such, by including generators in the settlement residue refund process, a wider benefit is felt throughout the NEM market, benefiting both generators and customers.

6.5 Customers

This group will receive lower generation prices as all customer pay prices subject to losses. Currently not all of this stakeholder group benefits from the settlement residue refund, so by including all customers in the benefit of average loss factors, a wider economic gain will be felt by all users of the market. This goes on to support the NEO principles of promoting efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity.

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