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PO Box A2449
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Lodged electronically: www.aemc.gov.au (ERC0251)

Dear Commissioners,

AEMC 2019, Transmission Loss Factors Consultation Paper

We welcome the opportunity to comment on the AEMC's consultation paper on Adani Renewables two rule change requests.

EnergyAustralia is one of Australia's largest energy companies with around 2.6 million electricity and gas accounts in NSW, Victoria, Queensland, South Australia, and the Australian Capital Territory. We also own, operate and contract an energy generation portfolio across Australia, including coal, gas, battery storage, demand response, solar and wind assets with control of over 4,500MW of generation capacity in the National Electricity Market (NEM).

Transmission Loss Factors (TLFs) are critical to the efficient operation of the NEM. Heating losses as electricity is transported along both high and low voltage transmission lines is not a new phenomenon nor can it be simply ignored (or totally socialised) given the sparseness and geographic size of the NEM. EnergyAustralia recognises the challenges and risks that year on year changes to Marginal Loss Factors (MLFs) can create for both existing and new generators and loads. The speed at which new renewable projects can be financed, installed and commissioned has led to large changes in MLFs, particularly when this new generation is installed far away from the Regional Reference Node (RRN) or in areas with limited transmission capacity.

Adani Renewables proposes two changes to the current MLF regime being a move from an MLF to an Average Loss Factor (ALF) and to allocate some of the current Intra-Regional Settlement Residue (IRSR) to generators[1]. They argue that 'inaccuracies' in the current MLFs distort the market and introduce inefficiencies and leads to additional IRSR accruing, which in their view should be returned to generators.

While we appreciate the challenges that using an annual forecast of static intra-regional loss factors create, EnergyAustralia is not convinced that there is any evidence to warrant a change from the current MLFs methodology to an ALF - or that it is in the best interest of customers or consistent with the National Energy Objective (NEO).

[1] https://www.aemc.gov.au/sites/default/files/2019-06/Adani%20Renewables%20consolidated%20rule%20change%20requests.pdf

Nevertheless, we consider that there may be several improvements that could be made to the MLFs process, these are discussed in more details below.

1. Current transmission loss factors in the NEM

The design choice of the NEM is that all supply and demand is settled at a common marginal clearing price, that is the price at a RRN must represent the marginal value of supplying an incremental increase in load at that time[2]. The decision to use locationally specific MLFs at each participant connection point to represent losses in the market is consistent with this and ensures dispatch efficiency and the accurate pricing of generation and demand. MLFs are also designed to achieve 'settlement adequacy' to ensure that physical losses incurred transmitting power long distances are payed for, which is essential. MLFs by design lead to settlements residues that accumulate and is then returned to consumers through reduced Transmission use of System (TUOS) charges[3].

Unlike (dynamic) inter-regional losses (which are calculated each dispatch interval based on the prevailing transfer level between regions) the rules specify AEMO must determine a methodology for the calculation of a single (static) forward looking intra-regional MLF to apply for a financial year at each connection point[4]. To calculate loss factors for each year AEMO uses:

- Connection point demand forecasts;
- Generator availability and dispatch (based on a minimal extrapolation from preceding years actuals);
- A mathematical representation of the entire transmission network; and
- A forecast of new/committed grid connections or network augmentations.

Using the above AEMO then models a sequential power flow simulation using half hourly market conditions to calculate the associated MLFs for each connection point across the NEM. The 'static' MLF for the next financial year at that connection point is taken as the volume weighted (based on generator/load volumes) average. AEMO must publish these static MLFs by 1 April each year for the following financial year.

Actual and simulated MLFs are inherently a function of the prevailing and locationally specific dispatch conditions, the physical properties of the transmission assets (transmission lines, terminal stations and transformers), and the operating conditions of the power system – in particular, the voltages across the system.

MLFs are fundamental to the efficient design and dispatch of the market and used in a number of areas, including:

[2] NER 3.9.2(d)

[3] In reality IRSR are payed to Transmission Network Service Providers (TNSPs) who then use this to offset TUOS charges to customers.

[4] NER 3.62

- The dispatch process - To refer bid offers from the connection point to the RRN. For example, generators have their *bid offers ÷ MLF* to reflect their location and ensure an efficient marginal clearing price is set.

- The settlement process - to calculate settlement prices for connection points. For example, generators are paid their *generation x RRN price x MLF*.

- Their inherent application as a one of the strongest locational pricing signals to new connections. For example, a prevailing high MLF signals a good location for generation (due to the settlement impact), vice-versa for loads.

- Certificate creation - MLFs are used to calculate the quantity of Large Generator Certificates (LGCs) that are created by a generator.

Specifically, and as noted, MLFs are used directly in AEMO's 5-minute dispatch process to translate location-based unit offers to the regional reference node. For example, if a generator has an MLF of 0.9 and its bid price is $90/MWh at its generator terminals (i.e. at its connection point) - then AEMO will apply the marginal cost of the next unit of generation from this location as $100/MWh ($90MWh/0.9). In this way the NEM Dispatch Engine (NEMDE) directly incorporates losses into its marginal clearing algorithm and therefore inherently ensures an efficient dispatch process. With two generators offering the same bid, the one electrically closer to the node (higher MLF) will be dispatched first as it will result in lower losses occurring.

2. Difference between average and marginal loss factors

Given the nature of the rule change proposal, it is central to understand the difference between ALF and MLF. An ALF will represent the absolute or real losses to transfer a defined amount of power along a transmission line to meet a load requirement. On the other hand, an MLF represents the losses to meet the next marginal MW of load. For example, to meet a reference node load of 100MW a generator supplies 103MW, therefore the ALF (for the load) is 1.03. To supply an additional 1MW of load at the same reference node the generator must produce 104.06MW meaning that the MLF is in fact 1.06. This highlights the physical relationship that losses do not increase linearly with an increase in power transferred, but in fact increase with the square of the power transferred in the line (I^2R)[5].

Using ALFs in AEMO's dispatch processes (as oppose to MLFs) would result in inefficient dispatch outcomes. Generation further from load centres would be dispatched ahead in the bid stack (due to the difference between ALFs and MLFs) therefore resulting in less efficient outcomes for dispatch and in the end customers.

3. Challenges with current methodology

Historically, MLFs were relatively stable due to the location of and nature of legacy base load, intermediate and peaking dispatchable generators and relatively fewer and more predictable entry of new generation and/or load and network augmentations. They tended to vary year on year based on variable transfers between regions, for example, as affected by wet or dry seasons, or long term planned outages.

[5] https://www.energycouncil.com.au/analysis/marginal-loss-factors-will-someone-please-repeal-the-laws-of-physics/

Over the last decade and notably in the last few years we have seen several regions and locations see large changes in MLFs, due to:

- Increasing intermittent renewable generators, often located far away from load centres (the RRN) resulting in higher losses.

- Large changes in flows on interconnectors between regions driven often by increases in intermittent generation (and or behind the meter demand reductions) which can result in large impacts on generator/loads where interconnectors terminate.

- Lack of transparency around related projects all connecting in a similar region (for example, Western Victoria), further exacerbated when technologies with similar profiles connect in same region, for example solar.

Due to the forward-looking nature of AEMO's MLF methodology assumptions around new build can have a significant impact on loss factors. For example, any delaying in commissioning of new plant (due to connection issues, for example) could result in large inaccuracies in the forecast MLF for the following year. Moving to an increased frequency of calculation of loss factors (for example every six months) could help in this regard by reducing the variability in forecast over longer outlooks.

4. Accuracy and certainty of MLFs

In its rule change proposal Adani suggest that the current rules result in high inaccuracies and hence distort the market through inefficiencies in operational and investment decision making[6]. There is limited data or evidence presented by the proponent to support this.

Care must be taken when claims are made that current loss factors are inaccurate. The forward-looking nature of AEMOs methodology (and hence the uncertainty in the accuracy in forecast inputs) will always result in 'inaccuracies' or rather variability in the calculation of loss factors regardless of the choice of using MLFs or ALFs. One way to reduce this inaccuracy would be to move to a dynamic loss factor, calculated every dispatch interval, as per inter-regional loss factors.

The current simplification of calculating MLFs, that is using one 'static' loss factor for the entire year, referenced to the RRN is a balance between deliverability, accuracy and certainty. Any decision to change current methodology requires careful consideration of the impacts between certainty and the accuracy in reflecting losses. For example, grandfathering MLFs would provide absolute certainty over an extended period of time but would come at the expense of significantly reducing the accuracy of MLFs, likely at a detriment to end use customers.

The trade-off between certainty and accuracy has direct impacts on customers. More accurate loss factors will result in more efficient dispatch at the expense of certainty of year on year changes (or even in real time). More certainty effectively transfers the risk of changing loss factors from generators to customers.

[6] Page 1, Adani Rule change request, https://www.aemc.gov.au/sites/default/files/2019-06/Adani%20Renewables%20consolidated%20rule%20change%20requests.pdf

We note that the Co-ordination of Generation and Transmission Investment (COGATI)[7] work that the AEMC is completing is considering changes to how wholesale prices are settled in the NEM and that this might result in wider changes to how transmission losses are considered.

5. Locational signals are critical

While MLFs are used in the NEM for a number of purposes (as highlighted previously) critically they are used as a significant locational signal for both generation and load. A location with a high MLF (>1) indicates that this location would advantage a generator whereas a location with a low MLF (<1) would disadvantage generation at that point[8]. For load the opposite is true.

MLFs currently provide a relatively strong signal that investment in some locations in certain generation types (due to the volume weighting) is unlikely to be as economically efficient as other locations. Moving to an ALF will blunt these location signals, potentially leading to poor outcomes for customers. Increasingly we are seeing new entrant generators building in areas with the best solar or wind resource but with no apparent consideration of likely losses to transport this generation to the load centres as indicated by the locational MLFs. This can often result in poor transmission loss factors (and at times additional congestion) impacting these generators. Additionally, MLFs remain somewhat reflective of the incremental impact of new generator connections at a location, ALFs do not retain this incremental signal as strongly.

ALFs would have the impact of compressing all loss factors closer to 1 (regardless if >1 or <1) and therefore provide weaker locational investment signals for new investment. This is likely to result in more investment in areas that in practice could have very high losses. While higher loss factors (closer to 1) will benefit these generators, it is not clear if this is at all in the best interest of consumers and is likely to result in inefficient dispatch.

Further, it should be noted that as moving to an ALF would result in all loss factors moving closer to 1 that there will be winners and losers, for both generation and load. For example, an area that’s loss factor moved from 0.80 to 0.90 due to a change from MLF to ALF would result in a generator being better off by this change, but conversely the impact on any transmission connected load at this point would be equal and opposite. In this sense it is a direct transfer of impact (and revenue/costs) between generators and loads. It is also not clear whether there will be a net sum gain or loss in any transition from marginal to absolute losses.

6. Additional transparency and publication loss factor data sets should be strongly encouraged

While EnergyAustralia does not support a change from MLFs to ALFs for the reasons outlined above, we are supportive of additional transparency being provided by AEMO and prospective generators or customers to improve the forecasts of loss factors. We note that the AEMC is currently consulting on 3 rule changes which may go somewhat in

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[7] https://www.aemc.gov.au/market-reviews-advice/coordination-generation-and-transmission-investment-implementation-access-and

[8] This is because the MLF is used in the settlement process to reflect the price paid to generators (and price payed by load) at each location.

addressing this issue[9]. Improving this aspect would help address the root cause of the MLF challenges being created.

AEMO has also indicated that they are exploring publishing non-binding forecasts of MLFs before final MLFs for that period are released. This should help participants to understand ongoing change to loss factors while also limiting 'shock' when the binding MLFs are released. We support this approach. AEMO should also continue to improve education to both existing and prospective generators and loads around what MLFs are and the drivers of changes.

Whilst recognising that the last significant change to the loss factor methodology occurred in 2002 with the transition from a purely historical calculation of MLFs to a forward-looking methodology. EnergyAustralia considers that a focus on improved forward looking MLF accuracy in the future needs to be informed through changes that promote the availability of data allowing an analytical and evidence-based environment for existing and pending participants to understand and examine power system losses and loss factors[10].

This is particularly the case as the operation of the market and power system has evolved with the development of significant intermittent renewables over the past decade or so. We now tend to see almost two binary modes of operations – oversupplied windy and sunny conditions coupled with low to moderate demand that leads to very high voltages and low prices and relatively low losses - or alternative high load, very low voltages, high traditional thermal generation and therefore high losses[11]. This suggests there may be identifiable modes or clusters of losses subject to the prevailing conditions (not necessarily seasons or traditional peak off peak times).

We would support an enhanced approach to forecasting loss factors that focused on four progressive stages:

1. Absolute disclosure and publication of all inputs, assumptions and outputs of the current calculation methodology – by half hour and by location.
2. Calculation and ongoing publication of actual loss factors and the prevailing power flow conditions.
3. Comparison and investigative back-casting analysis of the differences between the forecast versus actual MLFs and power flow conditions (possibly using measures such as Mean Absolute Percentage Error (MAPE)).
4. Findings and recommendations for improvements, possibly corrections due to manifest errors, or simply insights into causes for variances that are not expected to be repeated in the future.

In EnergyAustralia's view the key structured data sets of forecast and actual parameters would include, but may not be limited to:

[9] https://www.aemc.gov.au/rule-changes/transparency-new-projects

[10] We note if anything the direction has been to reduce the information available to participants as AEMO no longer publishes the associated standard deviation with any of its annual static locational MLFs.

[11] To the extent that AEMO now turns off transmission lines to help manage overvoltage's during very light loading, and recognising that losses are not only a function of the square of current but also the square of voltage (I^2R and V^2/R), so highly sensitive to prevailing operating conditions.

- The calculated MLF and ALF at each connection point for each interval. So that each interested participant can determine their own view of variability, seasonality, time of day, average, standard deviation, etc.
- Generation and load profiles assumed at each connection point for each interval as well as interconnector flows.
- The voltage at each connection point. EnergyAustralia believes that differences between simulated and actual voltages may be a significant source of MLF forecast error, especially as it is understood the TPRICE load flow model has historically been tuned for peak, or at least singular demand conditions.
- Absolute losses across each region.
- The impedances/resistances used in the load flow model, and the network configuration/standing data and how/when it is forecast or changes over the forthcoming year.

Establishing the reporting and knowledge sharing framework as described, together with publication of the structured ex-ante and ex-post data sets as well as annual insights and recommendations by AEMO will provide a significant level of positive assurance to all existing and market participants.

7. Generators are best placed to mitigate this risk

Moving to ALFs would have the impact of transferring some of the location risk or uncertainty to the end use customer with the resulting de-risking of any generator investment having to be repaid to customers through lower capital costs (presumably through lower wholesale costs). Customers are unlikely to be best placed to manage this locational risk (nor are they positioned to understand it) and are already being asked to take on significant risk that the market benefits of increasing network spend do not eventuate due to the uncertain nature of the future state of the NEM. Therefore, there appears to be no significant justification that moving from MLF to ALF is clearly in the best interest of the customer.

Further, customers are increasingly being asked to fund build out of congestion, and to some extent losses. For example, it is likely that the Western Victoria Renewable Integration Project[12] will recommend that additional transmission be constructed to relieve congestion in the region due to excessive build of new generation in a poor transmission connected area. As ALFs further dampen the location signal then there is increasing potential for similar issues to eventuate in the future across other areas of the NEM. Customers should not pay for poor locational investment decisions.

8. Customers pay for transmission

In the NEM generators do not pay for use of the shared transmission network[13], rather customers pay for all new and ongoing transmission costs through published prices and associated TUOS charges. As MLFs tend to over recover for losses in the network (by design) this IRSR is returned to customers through a reduction of future TUOS charges. Regardless of how accurate the forward looking MLF calculation is, IRSR will still

[12] https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Victorian-transmission-network-service-provider-role/RITT

[13] Generators pay only an initial connection payment plus generally an ongoing annual connection cost to the TNSP.

accumulate. As generators do not pay for the use of the transmission network it does not seem reasonable that they should receive a significant share of this IRSR.

It is not clear to EnergyAustralia the magnitude of this IRSR that accumulates in all regions and we would urge the AEMC with help from AEMO to provide more information on the materiality and any trends of this residue. We note that if the NEM was to move to ALF that IRSR would likely reduce and in fact could result in generators owing money to TNSPs due to negative IRSR accumulating. It is unclear if this has been considered in the rule change requests.

Adani argues that 'errors' between forecast and actual loss factors undermine efficient dispatch and undermine investment signals. Returning IRSR to generators will not address the root cause of the problem and focus should be on improving transparency and symmetry of information to improve the loss factor forecasts through the forward-looking methodology.

9. Discussion of other options

Any changes to TLFs should be applied consistently across all generation and load types, scheduled, semi-scheduled and non-scheduled.

Use of multiple loss factors

EnergyAustralia supports the investigation of utilising multiple MLFs to improve forecast accuracy. For example, AEMO could use different loss factors for seasons, quarters or 6-monthly, or based on prevailing conditions.

Based on any evident modes or clusters in the forecast MLF's supported by statistical parameters, AEMO could extend their annual static loss factors to include bi-modal loss factors for more specific network and generation conditions. For example, loss factors could be calculated separately for high and low load conditions, reflecting as discussed earlier the large impact that actual power flows and voltage levels can have on losses. This would likely improve the accuracy of MLFs and would align with actual physical conditions of the power system by allowing times of discretely different loss conditions to be captured. The challenge here would be determining and establishing in a pre-defined and agreed manner the switch criteria to determine what would be a clear pair of modes, and then when to change between the modes in practice. We would support further work being done by both AEMO and the AEMC to investigate the potential of this and consider the treatment of dynamic loss factors for tidal flowing interconnectors as a representative precedence of how and why this could be done.

We note that all the above will be a trade-off between the forecast accuracy and certainty over a forecast period of time.

Collar or cap

While implementing a collar or a cap (for example, a cap on year on year changes) would provide more certainty around movements in MLFs and soften transitions, it would categorically come at the expense of accuracy given its interventionist and subjective threshold trigger. Additionally, it would blunt the locational signal (similar to ALFs) and would introduce additional questions around how to select the level of these, particularly for existing and new generation. The AEMC should consider these impacts in detail and provide additional information before proceeding any further down this path.

Grandfathering

This would result in absolute certainty in MLFs (depending on length of grandfathering) but would come at the expense of any accuracy or potentially locational signals. As with a collar or cap the AEMC should consider these implications in detail before going any further.

Utilising MLF in dispatch and ALF in settlement

Marginal pricing needs to be maintained beyond simply the dispatch process and into actual settlement quantitates. If some form of rebate is provided (e.g. to reflect average losses) in settlement, then any prudent operator would simply adjust their behaviour to take advantage of this.

10. Conclusion

EnergyAustralia recognises the challenges that year on year varying MLFs are currently creating for some generators and participant loads, but we do not consider that there is sufficient evidence to move away from the current forward looking MLFs approach, for example to an ALF. Using ALFs in the NEM would not only blunt locational signals and result in inefficient dispatch but also does not address the root cause of the loss factor issues.

We are supportive of additional transparency to stakeholders as well as AEMO efforts to improve their MLF forecasts by establishing and publishing more robust data and analytical based insights into the forecasts and the actual loss factors while also assuring there is symmetric information to all parties. Further we see that there are potential improvements that can be made to the accuracy of MLFs by considering multiple loss factors across a year (as opposed to a single loss factor) noting that this does come with a reduction in certainty for generators.

Customers pay for the transmission network and therefore should continue to receive the IRSR.

If you would like to discuss this submission, please contact Andrew Godfrey on 03 8628 1630 or Andrew.Godfrey@energyaustralia.com.au.

Regards

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