AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

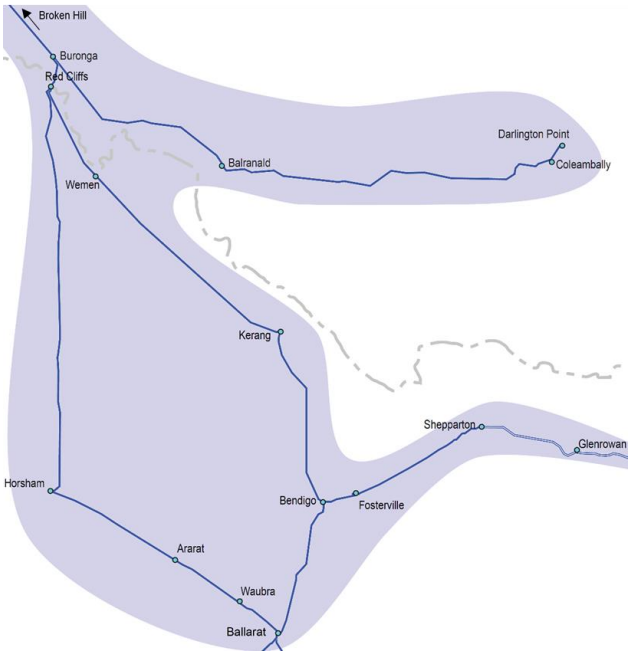
Generator Connections to the Western Victoria Transmission Network

Questions and Answers

Updated March 2019

What is the issue?

The map to the right shows a snapshot of the Western Victoria transmission network.



There are a number of wind and solar farms connected to this network, including the following large-scale generating facilities:

- Waubra Wind Farm (WF) (192 megawatts [MW])
- Ararat WF (242 MW)
- Bannerton Solar Farm (SF) (88 MW)
- Karadoc SF (90 MW)
- Wemen SF (88 MW)
- Kiata SF (30MW)
- Gannawarra SF (53 MW).

Other committed projects with planned commissioning in early 2019 include:

- Crowlands WF (80 MW)
- Bulgana WF (204 MW)
- Murra Warra I WF (226 MW).

Murra Warra II WF also finalised connection agreements at the end of 2018, and is targeting commissioning in March 2020.

Associated network constraints may result in limitations on the generating capacity of semi-scheduled and scheduled generating systems.

Interest in the development of new wind and solar farms in north-west Victoria remains high, including projects successful in the Victorian Government's renewables auction under the Victorian Renewable Energy Target (VRET).

There have also been several hundred megawatts of recently committed wind and solar in South-West New South Wales, which also may impact generation import into Victoria via Red Cliffs Terminal Station (RCTS).

Further generation development will add to the thermal and stability constraints, and further reduce the marginal loss factors (MLFs) for generators in this area.

What does this mean for me as an existing or future wind or solar farm developer?

If the loading along the transmission lines in this area exceeds the thermal limit, or stability limits are exceeded, the amount of generation output that can flow through that line will be restricted. When that happens, generators or groups of generators located on these lines will dispatch at less than their full output. This problem will be exacerbated as the number of connections increase along these lines. Note, that if AEMO considers it necessary for adequate system operation and maintenance of power system security, generators below 30 MW may also be included in central dispatch.

In order to manage the potential impact of single-contingencies on power system stability, AEMO anticipates a need to limit the combined output of generation in north-west Victoria in the near future.

Due to low system strength in north-west Victoria, additional constraints and remediation works are likely to be required for all new or modified generation connections, to ensure stable operation. These works may include installation of synchronous condensers or other plant to raise fault levels. High volumes of existing

and contracted generation in the area mean that additional special protection schemes to manage system strength impacts are unlikely to be feasible due to their impact on power system security (in some cases they may result in ancillary services and stability limit constraints).

For more information on system strength, see the System Strength Impact Assessment Guidelines published by AEMO and effective from 1 July 2018[1]. This document outlines the principles and methodologies used to assess the system strength impacts of a new or modified generating system.

Given these considerations, new or modified connections in this area will be more difficult and time-consuming to assess and could require significantly more expensive plant adjustments and additions. Generator access to the network is not guaranteed under the NEM framework, and the output of connected plant is likely to be constrained more frequently and to a greater degree.

How will my generator's output be affected?

Several factors can affect the order in which generators are dispatched, and the amount by which they could be constrained. In addition to variable operational conditions and economic considerations (including bid amounts), the location of each generator relative to the constraint and to each other may be a significant factor.

Voltage stability and ancillary service constraints are likely to result in pre-contingent constraints being applied to generators (or groups of generators) to limit the total lost generation for a single contingency to approximately 600 MW. Pre-contingent constraints include not only any generators that would trip as a direct result of a specific fault, but also any remote generators that trip or reduce output on a control scheme action following the fault.

As discussed above, there will be an increasing need to apply pre-contingent constraints to ensure the power system is operated to within its technical limits. Constraints can be particularly onerous during prior planned and unplanned (forced) outages. When reviewing proposed planned outages for maintenance and upgrades, AEMO takes into account a number of factors, such as forecast demand, generator availability, interconnector availability, weather conditions, gas outages, other line outages, and constraints. AEMO applies operational constraints to generators to ensure the system is operated in a secure state. The north-west Victorian network essentially has three AC connections to the main system, via Darlington Point, Ballarat, and Bendigo/Ballarat. During a prior outage of one of these three connections, AEMO plans for the loss a remaining connection, which subsequently radialises the entire north-West network via a single connection to the main system. As a consequence, there may be periods where generators are curtailed or required to disconnect.

Whether and how a particular generator is impacted will depend on its characteristics, location, system strength limitations, and connection configuration. Establishing the potential impact on a particular project requires detailed studies using accurate computer modelling information provided by Generators. Any future connections could materially change the outcomes.

Are there other future risks or limits that may impact my output?

There are many possible outcomes or scenarios that could increase risk for generators in north-west Victoria.

As one potential example, AEMO is currently investigating the impact of high densities of solar and wind generation, including the potential for rapid ramping events, at various geographical areas.

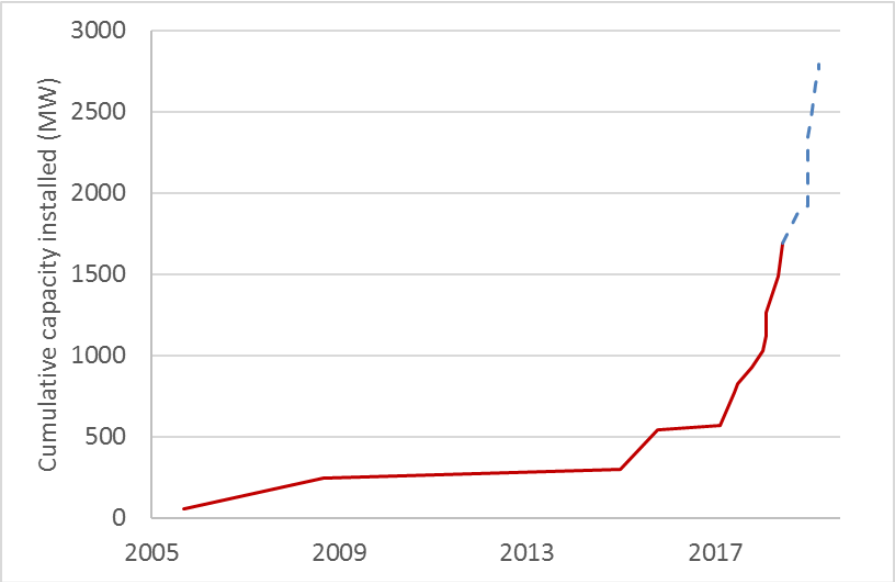
In the event adverse impacts on the power system are identified, AEMO would need to take measures to manage power system security. This could include constraining generation, particularly during periods where environmental conditions result in a significantly higher risk.

Can AEMO stop new connections in the area?

AEMO must process every connection application it receives and make offers to applicants who meet the relevant National Electricity Rules requirements. There has been a significant increase in connections over the

[1] At https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/System-Strength-Impact-Assessment-Guidelines.

past several years which is illustrated in the graph below. Subject to certain conditions, AEMO can make current network data available for intending participants to conduct their own studies on the implications of these constraints on their proposed projects.



AEMO is assessing whether it can plan to augment the capacity of the relevant transmission lines. This can only be justified if there are sufficient net benefits to the broader market (that is, not solely to benefit connected or connecting generators). This transmission planning process is described in more detail later in this document.

How does this impact Marginal Loss Factors?

If power flow from an area of the network increases in the direction of the regional reference node (RRN), the generator MLFs for that area will decrease. In Victoria, the RRN is at Thomastown in Melbourne.

The connection of new generation in north-west Victoria has increased power flow from that area toward the RRN and contributed to MLFs in the area decreasing, with some generators experiencing a decline of several percent year-on-year. The connection of additional generation will likely cause the MLFs in the area to drop further.

If the transmission network connecting the north-west Victoria area to the RRN is augmented, the MLFs in the area could increase toward 1. The materiality of any change in MLFs would largely depend on the nature of the augmentation.

Several other factors can also impact MLFs, including changes in local demand growth and behaviour, changes in interconnector flows, and retirement of baseload generation. Initiatives that encourage changes in demand patterns – such as the Victorian Solar Homes program (installing rooftop solar panels on 650,000 Victorian homes over a 10-year period) – may accelerate these changes.

How is AEMO addressing this situation?

AEMO is currently conducting a Regulatory Investment Test for Transmission (RIT-T) to assess solutions to address forecast network congestion in Western Victoria. The purpose of the RIT-T is to identify credible options to relieve congestion and to increase the capability of the power system to facilitate the connection of new generation in this area where it will result in a positive net market benefit.

A number of reports are published throughout the RIT-T process that outline the identified options and seek consultation from stakeholders[2]:

[2] Western Victoria RIT-T reports and other information is available at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Victorian-transmission-network-service-provider-role/RITT.

- AEMO published the initial report, the Project Specification Consultation Report (PSCR), on 21 April 2017. It described the identified need, relevant categories of market benefits, network options being considered, and the technical characteristics and performance requirements any non-network option would need to deliver.
- The second report, the Project Assessment Draft Report (PADR), was published for consultation on 14 December 2018. It identified the market benefits for all credible options considered and defined a preferred for staged development including upgrades to be delivered in the short term (present to 2021) and medium term (2021 to 2025) to increase the thermal capacity of the Western Victoria transmission network.
- In the third report, the Project Assessment Conclusions Report (PACR), AEMO will respond to submissions in response to the PADR and conclude on the preferred option. This report is scheduled for publication in mid-2019.
- Assuming a preferred solution is identified, the project approvals, design, and construction timeframe is likely to be 4-7 years.

This RIT-T marks the first step in Victoria for what is a much larger, strategic transmission infrastructure development plan underway to assess and coordinate future transmission and generation across the National Electricity Market, as outlined in AEMO's 2018 Integrated System Plan[3].

ElectraNet's South Australian Energy Transformation "RiverLink" project has also been exploring options to facilitate energy transformation. In February 2019, ElectraNet released the South Australian Energy Transformation PACR, the final step in the RIT-T process[4]. The PACR identified a high-capacity interconnector between South Australia and New South Wales, with an added connection to north-west Victoria including a new line between RedCliffs and Buronga, as the preferred option to generate a range of benefits for South Australia, New South Wales, and Victoria.

What can I do to reduce the impact of system constraints?

There are a number of actions you could consider that could assist in alleviating the network congestion, including the following:

- If your project is in its early stages, assess the extent to which additional plant costs, unpredictable constraints, or loss factors could impact project viability, and consider alternative options.
- You could investigate potential energy storage solutions to store excess electricity generated by your wind or solar farm.
- Remediation works to address system strength limitations could be added at your cost. Due to the weakness of the network, this may limit the feasible system strength remediation options available.
- The connection could be configured to minimise ancillary services constraints. AEMO's preference is for connected parties to be fully switched, but alternatives may be considered in some circumstances.
- You could consider technology outputs (generation sources) which are complementary/anti-correlated to existing generators.

If the outcome of the Western Victoria RIT-T is that the preferred solution does not yield a sufficient net market benefit to warrant a network augmentation, you could fund the cost of augmentation or other works by the network service provider to alleviate the network congestion.

You should note that if you fund an augmentation to the network for the purposes of your project, exclusive access to the increased network capacity is not guaranteed.

What if I need more information?

For connection enquires – connections@aemo.com.au

For Western Victoria RIT-T enquiries – planning@aemo.com.au

[3] At https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Integrated-System-Plan.

[4] Documents and information about the project are available at https://www.electranet.com.au/projects/south-australian-energy-transformation/.