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6 October 2023
Nicola Falcon
Group Manager Victorian Planning & Connections
Australian Energy Market Operator (AEMO)

Via email: systemstrengthVIC@aemo.com.au

Dear Nicola

Victorian System Strength Requirement Project Specification Consultation Report

AusNet welcomes the opportunity to make this submission in response to the Victorian System Strength Requirement Project Specification Consultation Report (the PSCR).

AusNet is the largest diversified energy network business in Victoria with over $11 billion of regulated and contracted assets. It owns and operates three core regulated networks: electricity distribution, gas distribution and the state-wide electricity transmission network, as well as a significant portfolio of contracted energy infrastructure. It also owns and operates energy and technical services businesses (which trade under the name "Mondo").

Alongside South Australia, Victoria has been at the forefront of rapidly declining system strength – with issues previously concentrated to specific REZs now being experienced more broadly across the Victorian network. Today, various combinations of synchronous generation units must remain online at all times to support the secure and reliable operation of the system. Some parts of the network are now unable to support the connection of new renewable generation or require the procurement of expensive individual remediation solutions. It also increasingly difficult and costly for NSPs to plan and undertake critical outages. Without investment, these issues are expected to become more prevalent as the number of Victorian coal units declines significantly from 2025-26 onwards and system strength falls below minimum requirements.

For these reasons AusNet strongly supports and welcomes the PSCR as an important step to resolve urgent and material system strength issues affecting the Victorian transmission system through a coordinated and efficient solution.

AusNet is aware that AEMO Victorian Planning (AVP) has outlined an equivalent network solution of synchronous condensers to meet a system strength standard determined by requirements published by AEMO National Planning. We understand AVP is considering a portfolio of network and non-network solutions to address this identified need and that solutions will be assessed via a full options analysis at the Project Assessment Draft Report (PADR) stage.

With these considerations in mind, AusNet has undertaken independent power system analysis and consulted with our transmission operations team to provide AVP with some early feedback for consideration as it prepares the more detailed PADR. More specifically, we:

- **Confirm the system strength services proposed in the PSCR meets the current standard**. AusNet's preliminary analysis confirms the proposed equivalent network solution of nine 250 MVA sycons would meet the pre and post contingency minimum fault level requirements at declared system strength nodes as the number of Victorian coal units online is reduced.
- **Request AVP take into account the need to facilitate critical planned outages when identifying solutions to meet minimum standard in the PADR as a matter of priority.** Planned outages are an essential BAU activity to conduct essential maintenance, connections, augmentation works and capital replacement. Deteriorating network operating conditions have required AEMO National Planning to introduce or modify constraints in Victoria that have made it very difficult for TNSPs such as AusNet to schedule and undertake planned outages. Outage windows are now significantly reduced and in some cases near impossible to schedule. Such work is

fundamental to: mitigate against asset failure and unplanned outages; reduce developer curtailment costs and avoid the need for expensive market options to facilitate planned outages.

- **Request AVP consult with AusNet's transmission operations team to ensure the list of critical planned outages is accurate and up to date.** While AVP is not responsible for publishing the list of Victorian critical planned outages in accordance with the required definition and criteria, there is currently no process for AusNet to input into the December 2023 System Strength Report which AEMO National Planning is expected to be released prior to the PADR. AusNet's asset management role brings with it practical knowledge about the condition of all network assets, planned outage challenges and associated risks. In our view the list of Victorian critical planned outages in the 2022 System Strength Report is incomplete.
- **Suggests the system strength standard needs to be updated to meet Victoria's future needs.**

  In order to meet the standard, the solution proposed in the PSCR focusses investment in syncons at Hazelwood (HWTS) and Moorabool Terminal Station (MLTS) that then serve to 'prop up' system strength across the Victorian network. AusNet is concerned that placement of systems strength at these locations is inefficient and reflects historical needs.

  AusNet sees an opportunity for AEMO National Planning to update the system strength standard in the 2023 system strength report to reflect material changes in Victoria's future needs since the 2022 ISP, before proceeding to the PADR in early 2024. This includes declaring new system strength nodes where new network investment is planned, and updating minimum and efficient fault level requirements. Proceeding with the existing standard would be a missed opportunity to maximise the benefits of this investment to Victorians.
- **Suggest the PADR explore a more dispersed portfolio of system strength solutions that supports generation connections in renewable energy zones as generation in the Latrobe Valley is reduced.** Our preliminary analysis investigated the merits of alternative credible solutions that meet Victoria's needs by considering a more dispersed portfolio of 250 MVA and 125 MVA of syncons than the PSCR with approximately the same total MVA capacity. This includes deploying syncons at declared system strength nodes, but also non-declared nodes such as Bulgana and Heywood over the forecast period.

  Early findings suggest a more dispersed portfolio of solutions has a greater ability to uplift hosting capacity in Victorian REZs, which have strong developer interest particularly after the completion of committed transmission projects. For example, a more dispersed portfolio of syncons could support approximately 3,500 MW of new IBR in the Western Victoria REZ (V3) following the completion of Western Renewables Link compared to approximately 1,600 MW in the PSCR's proposed equivalent network solution. It is also better able to resolve issues with undertaking planned outages by more evenly distributing system strength across the Victorian network.
- **Suggest the PADR consider high benefit network reinforcement solutions.** AusNet has identified and examined four network reinforcement solutions, specifically new transformers and turn-in projects which can be delivered within similar timeframes to non-network solutions. Our preliminary analysis suggests that these solutions offer a wider range of market and essential system service benefits during both system normal and post-contingency conditions compared to non-network alternatives.

These points are addressed in further detail in the attached submission. If you have any questions regarding AusNet's submission, please contact Jason Jina, Energy Policy Lead by email at jason.jina@ausnetservices.com.au.

Sincerely,

David Beavers

David Beavers
General Manager, Network Infrastructure
AusNet

AusNet

AusNet submission in response to the Victorian System Strength Requirement PSCR

Australian Energy Market Operator (AEMO)

Friday, 6 October 2023

1. Introduction

AusNet welcomes the opportunity to make this submission to the Victorian System Strength Requirement Project Specification Consultation Report (the PSCR).

Under Victoria's declared network arrangements, AEMO Victorian Planning (AVP) is the transmission planner for the Victorian shared network which includes responsibility for the provision of system strength services under the new power system standard for system strength.

As the primary declared transmission system operator (DTSO), AusNet owns 99% of the existing Victorian shared network and is responsible for its operation, maintenance and replacement. We also work closely with many developers that are going through the transmission connections process in Victoria, which is also managed by AVP.

To inform our response to this PSCR AusNet has undertaken independent power system analysis that examines Victorian fault levels under system normal and credible contingency conditions when various system strength solutions are introduced across Victoria's Renewable Energy Zones (REZs). While preliminary in nature, this analysis has allowed us to better understand the investment need and merits of alternative equivalent network solutions that meet the system strength standard while providing additional market and reliability benefits to Victorians. A cost-benefit analysis has not been undertaken. We have also consulted with our transmission operations team that rely on supportive operational conditions (including system strength) to undertake planned outages on the Victorian shared network.

In this context, our submission:

- Welcomes the PSCR as an important step to resolve urgent and material system strength issues affecting the Victorian transmission system (Section 2).
- Highlights the importance of this RIT-T process taking into account the need to facilitate critical planned outages when identifying solutions to meet minimum fault level requirements (Section 3).
- Examines why the system strength standard and requirements should be updated (Section 4)
- Suggests there are benefits to exploring a more dispersed portfolio of system strength solutions that support generation connections in REZs, and network reinforcement solutions (Section 5).

We trust these observations assist AVP as it prepares the Victorian System Strength Requirements Project Assessment Draft Report (PADR).

2. Investment in system strength is much needed and welcomed

AusNet welcomes the PSCR as an important step to resolve urgent and material system strength issues affecting the Victorian transmission system.

While driven by a new regulatory obligation, the PSCR outlines the need for new sources of system strength to maintain power system security as the NEM transitions from a system with predominantly synchronous generation to one with high levels of grid-following inverter-based resource (IBR) generation and distributed energy resources (DER). We note the fact that this IBR generation is connecting to remote areas of the NEM already exposed to low system strength within the existing network topology.

Alongside South Australia, Victoria has been at the forefront of rapidly declining system strength. Since 2020, low system strength levels which were previously concentrated in the Western Victoria REZ (V3) and Murray River REZ (V2) have become a much broader issue across the network. For Victoria, declining system strength has been a major contributing factor as to why:

- Various combinations of synchronous generation units must remain online at all times to support the secure and reliable operation of the system including existing generation.
- Some parts of the network are now unable to support the connection of new renewable generation or experiencing connection issues without the procurement of expensive individual remediation solutions.
- It is increasingly difficult and costly for NSPs such as AusNet to plan outages in shrinking operational windows where no constraints bind and existing generation is not curtailed.

The AEMO 2022 System Strength Report confirms that without additional investment, system strength is forecast to deteriorate further in the near to medium term. It forecasts that the number of coal generators to be online in Victoria

will decline significantly from 2025-2026 onwards. For example, the number of Victorian coal units projected to be online under the ISP's Step Change scenario could, at times, fall to two units over the 2027-28 period. In our preliminary analysis, we observed fault levels drop by an increasingly large amount as each Victorian coal unit is removed from service. Further, all declared system strength nodes except Dederang Terminal Station (DDTS) fall below the minimum requirement when only two Victorian coal units are online.

For these reasons AusNet strongly supports and welcomes the proposed investment in system strength obligations for Victoria being met from 2 December 2025. The urgency and materiality of issues being addressed by this PSCR should not be understated.

3. Planning for critical outages

Planned outages are critical to maintain network reliability and facilitate the transition yet are becoming very difficult to schedule.

From time to time, transmission network service providers (TNSPs) are required to take transmission elements out of service to conduct essential maintenance, connections, augmentation works and capital replacement. These "planned outages" are an essential business-as-usual activity to maintain network reliability and security.

Planned outages require supportive operational conditions, often over several days, in order to go ahead. [1] Importantly, TNSPs are unable to undertake planned outages during periods of low system strength or where AEMO has concerns relating to voltage management, minimum demand and solar shake off.

During a planned outage TNSPs must maintain a sufficient level of system strength (and other essential system services) to keep the system secure (i.e. maintain fault levels). This can be difficult as synchronous or IBR generation may be constrained during the planned outage and the TNSP must always plan for the next contingency (i.e. N-1-1 conditions).

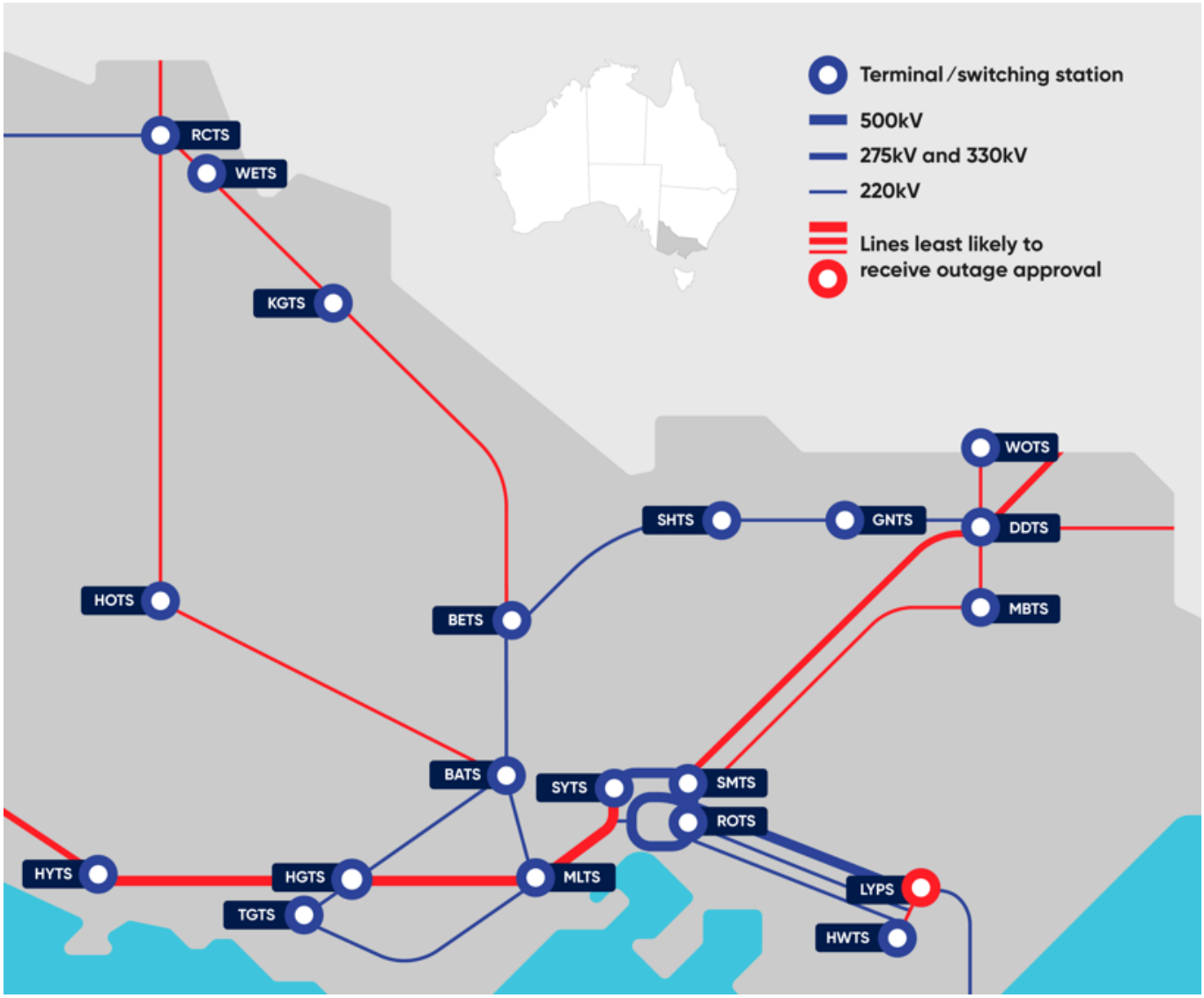
In order to manage system security issues arising from deteriorating network operating conditions AEMO Operations has introduced or modified an increasing number of constraints in Victoria and in other parts of the NEM.[2] AusNet is also seeing an increase in the number of assets being taken offline by nearby TNSPs as activity increases during the transition, which has made it harder to sequence planned outages, particularly on interstate pathways.

Collectively, these issues have materially increased the likelihood of constraints binding and made it difficult for TNSPs to plan outages in a window where no constraints bind. For AusNet, the winter months (June, July and August) are now the only reliable time to perform maintenance, and even then planned outages are still not guaranteed with last minute cancellations still occurring due to poor operating conditions and weather.

In addition to reducing outage windows, these issues have made it near impossible to schedule network outages on inter-regional support equipment, and more recently on the 330 kV network in the Central North REZ (V6). The figure below outlines the areas of the Victorian network that are least likely to receive outage approval.

[1] TNSPs are unable to undertake planned outages during periods of low system strength, where AEMO has concerns relating to voltage management, minimum demand and solar shake off, or there are poor weather conditions.
[2] A constraint equation can be considered as the "enforcement tool" used to keep the power system operating within the limits. Each constraint equation models a particular limit for a given power system configuration.

Figure 1: Areas of the Victorian network that are least likely to receive maintenance outage approvals.



Planning the network to allow critical planned outages to be taken has significant benefits for both market participants and customers. Notably it:

- **Avoids the need for more expensive market options to facilitate planned outages:** Permission to proceed with a planned outage is often dependent upon a combination of synchronous condensers and synchronous generators being online, and renewable generation dispatch below a defined threshold. Where this is not possible, AEMO Operations requests AusNet to either defer the work or enter into network support agreements (NSAs) to enable planned outages to proceed.

  While dependent on the outlook for wholesale prices, NSAs are typically very expensive option. This is because they rely on contracts with dispatchable synchronous generation, the cost of which is closely linked to the price of gas which has doubled in the last two years. It is possible that an NSA could cost several million dollars to enable a major replacement project to go ahead. For example, in 2021 AusNet estimated NSA costs to support the Moorabool Terminal Station circuit breaker replacement project planned in the 2023-27 regulatory period could cost $16 million. This cost is ultimately borne by Victorian consumers.

- **Reduces developer curtailment costs:** If planned outages cannot be efficiently scheduled due to deteriorating operating conditions, outages are not coordinated and taken at short notice often at the cost of developers. There are some lines in Victoria that require a minimum of 22 generators to curtail their capacity during an outage. We are also aware of some areas where generators have been curtailed by up to 10% over a 12 month period due to planned outages that affect their plant. Efficiently planning to allow outages to be undertaken can help reduce these energy market costs, which are ultimately passed onto consumers.

- **Supports timely connection of new generation:** New generation and storage that has reached the commissioning phase require planned outages to connect to the transmission network. Therefore, planning the network to allow planned outages to occur is fundamental to enabling connections to keep pace with Victoria's energy needs and emission reduction targets during the transition.

- **Mitigates against asset failure and unplanned outages:** If planned outages cannot be efficiently scheduled, TNSPs such as AusNet will be forced to delay replacement and maintenance of assets beyond the optimal timing.

Depending on the asset and specific circumstances, these delays could heighten the risk of asset failure and unplanned outages. For these reasons, there are also some critical works that cannot be deferred without creating unacceptable risks to safety, security and reliability.

We note these benefits are only likely to grow as synchronous coal units retire and we see an influx of new transmission augmentations and connections required during the transition, which further increases the need for planned outages.

We request that AVP take into account the need to facilitate critical planned outages when identifying solutions to meet the minimum standard in the PADR.

AusNet accepts that the AEMC's final system strength rule does not require AEMO in its national capacity to account for planned outage scenarios within the minimum standard itself. This recognised that adopting a minimum standard that accounts for all planned outages scenarios may in some cases result in inefficient outcomes.

However, the AEMC's final determination did recognise concerns raised by stakeholders about maintaining system strength during planned outages. It confirmed AEMO has scope to consider "critical" planned outage conditions in setting the minimum fault level within its annual system strength report and that SSSP's such as AVP should evaluate system strength solutions to cover outages on a case-by-case basis via the RIT-T process.

AusNet understands that AVP has not taken into account the need to facilitate critical planned outages in its PSCR but will consider critical planned outages highlighted in the 2022 System Strength Report on a case-by-case basis.[3] For the reasons expressed in this section, critical planned outages must be taken into account when identifying solutions to meet minimum standard in the PADR.

We also request AVP consult with AusNet's transmission operations team to ensure the list of critical planned outages is accurate and up to date, and share our concerns with AEMO National planning as part of its input into AEMO's 2023 System Strength Report. This recognises that:

- While AVP is not responsible for publishing the list of Victorian critical planned outages in accordance with the required definition and criteria, there is currently no process for AusNet to input into the December 2023 System Strength Report which is expected to be released prior to the PADR.
- AusNet's asset management role brings with it practical knowledge about the condition of all network assets, planned outage challenges and associated risks.
- In AusNet's view the list of Victorian critical planned outages in the 2022 System Strength Report in incomplete.

We consider this engagement would facilitate appropriate coverage of known planned outage scenarios that are the highest priority to undertake from a network reliability and security perspective. It would also ensure critical planned outages are being planned for in Victoria with equivalent confidence and consistency to other NEM jurisdictions, and minimise costs passed onto consumers.

4. The Victorian system strength standard and requirements should be updated

The equivalent network solution proposed in the PSCR meets the current system strength standard.

The PSCR outlines that AVP is considering a portfolio of network and non-network options to meet the system strength requirements and that solutions will be assessed via a full options analysis at the PADR stage. For the purposes of the PSCR, it identifies an equivalent network solution of synchronous condensers (syncons) to meet the Victorian system strength standard at each declared system strength node. This includes a total of nine 250 MVAr syncons and a temporary 125 MVAr syncon, (six 250 MVAr syncons and a temporary 125 MVAr syncon from December 2025, two 250 MVAr syncons from 2030 and a further 250 MVAr syncon from 2032).

AusNet's preliminary analysis confirms the proposed equivalent network solution would meet the pre and post contingency minimum fault level requirements at declared system strength nodes as the number of Victorian coal units online is reduced. We note that if the number of Victorian coal units were to fall to zero (i.e. lower than outlined in the 2022 System Security Report), system normal fault levels would be very close to minimum requirements with the loss of a 250 MVAr syncon becoming a critical contingency.

[3] AVP, *Victorian System Strength Project Specification Consultation Report, & RFI Webinar Q&As*, August 2023

However, applying the current standard further centralises system strength in the Latrobe Valley and Moorabool, which reflects historical needs and is inefficient.

As a result of these requirements, the solution proposed in the PSCR focusses investment in syncons at Hazelwood (HWTS) and Moorabool Terminal Station (MLTS) that then serve to 'prop up' system strength across the Victorian network. AusNet's preliminary analysis found that the proposed solution results in a further centralisation of system strength in the Latrobe Valley and Moorabool. For example, system normal fault levels at HWTS is approximately 12,000 MVA close to 1,000 MVA higher than today's minimum. While at MLTS system normal fault levels are approximately 9,900 MVA, close to 3,500 MVA higher than today.[4] Both significantly exceed minimum fault level requirements of 7,700 MVA and 4,600 MVA respectively when there are two synchronous units online in the Latrobe Valley.

AusNet is concerned that the placement of system strength at these locations is inefficient and reflects historical needs. The five syncons proposed for HWTS from December 2025 are designed to remediate system strength in Gippsland REZ (V5) to levels provided by existing coal units, but does not reflect the uncertainty about future requirements. For example:

- There is, at present, some uncertainty around the total amount of new onshore and offshore generation that will be supported in Gippsland compared to other Victorian REZs. Final outcomes are subject to ongoing investigations as part of the Victorian Government's Victorian Transmission Investment Framework and Gippsland Offshore Wind processes. They are also subject to the granting of applications for offshore feasibility licences by the Federal Government.
- The investment required to facilitate future interconnection with Tasmania is not yet known (i.e. Marinus Link Stage 1), and not expected to be energised until 2028-29 at the earliest.
- In the event onshore or offshore generation connects to a renewable hub within Gippsland REZ (V5) remote from HWTS, system strength remediation will likely be required at this remote hub.

At MLTS, only one syncon is proposed from December 2025 providing no N-1 redundancy. An additional two sycons are proposed from 2030 to support the connection of forecast IBR. Specifically, 1556 MW of non-committed Wind (970 MW) and BESS (586 MW) connections at Moorabool by 2033.

While AusNet supports timely investment in the South West Vic REZ (V4), we are receiving strong interest from generation and storage developers in V4 to the west of Moorabool. There are uncertainties with regard to the ability of three 250 MVAr syncons at MLTS to support network and generation needs across the wider South West REZ, and the likelihood that 1 GW of wind will connect at MLTS. For example:

- There are currently no committed wind projects at MLTS. Network capacity on the 220 kV circuits from Moorabool towards Melbourne are constrained by thermal limits at times of high wind and high Victorian demand.
- Future BESS systems at MLTS (from 2030) are likely to have grid forming technology, and are therefore unlikely to need system strength.
- In the event onshore or offshore generation connect to a renewable hub within the V4 REZ remote from MLTS, system strength remediation will likely be required at this remote hub.
- Planned outages on the SW VIC 500 kV network are extremely challenging to schedule, resulting in operational constraints that reduce generation output. Synchronous condensers at MLTS will do little to enable planned outages in SW VIC to the west of MLTS to proceed.

Furthermore, after assessing fault levels with synchronous units and syncons online it is recommended that:

- The maximum fault level at MLTS is confirmed.
- Operating procedures are introduced to ensure the number of Victorian synchronous generator units and synchronous condensers online do not lead to fault levels that exceed maximum fault levels at MLTS.

[4] Note our base case assumes six Victorian coal units online. Our analysis of the equivalent network solution assumes two Victorian coal units online at Loy Yang. We note that outcomes where zero coal units are online can be derived from our analysis.

There is an opportunity to update the system strength standard to meet Victoria's future needs.

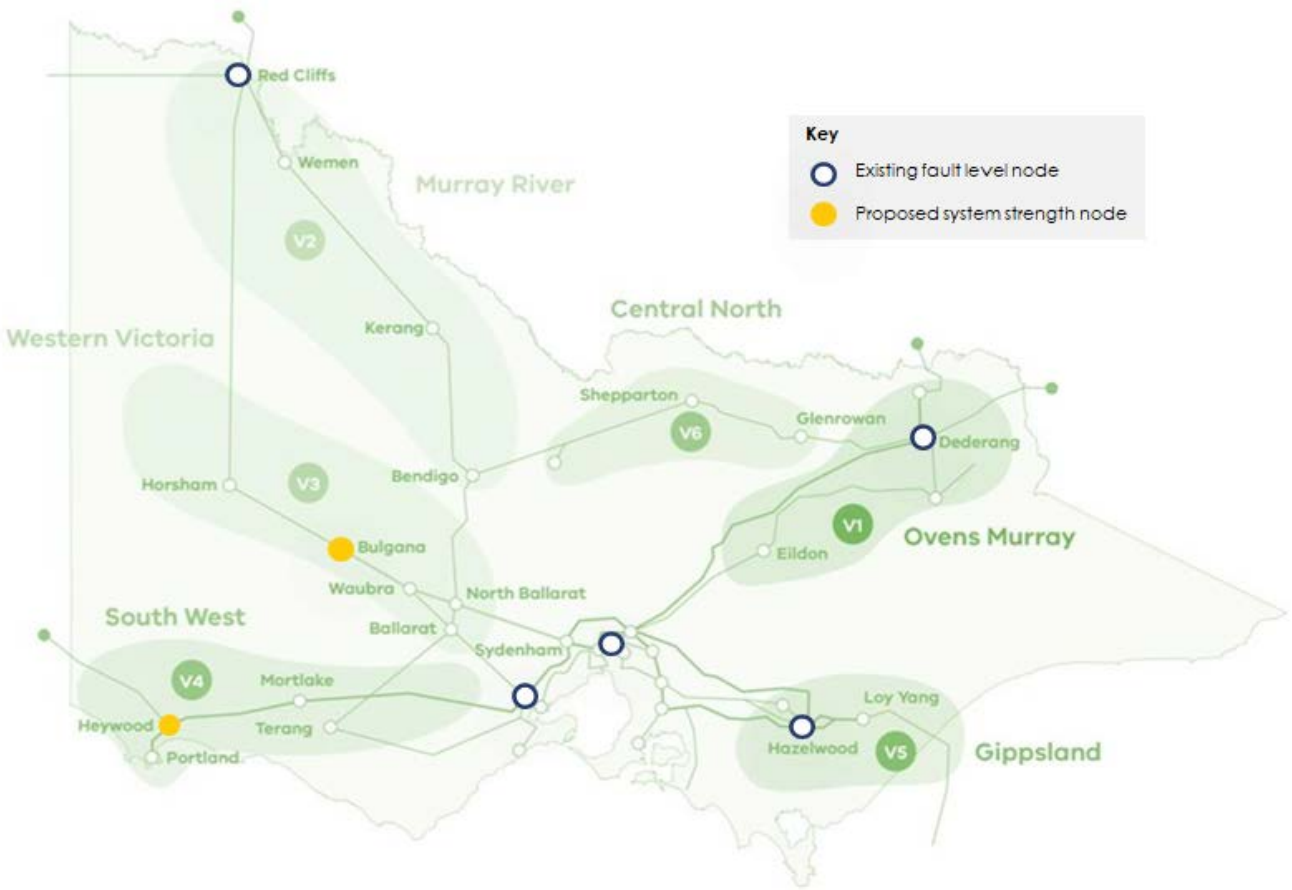
The PSCR rightly outlines that the provision of system strength services will need to be diversified from the Latrobe Valley (where most system strength is provided today) to support the forecast distribution of large-scale wind, solar and battery storage connections across all of Victoria. This conclusion appears at odds with the system strength standard.

AusNet acknowledges these standards are set in the annual System Strength report by AEMO National Planning function – to which AVP, as Victoria's System Strength Service Provider (SSSP), must make system strength services available (e.g. to meet minimum and efficient levels of system strength at defined system strength nodes).

Therefore, AusNet sees an opportunity for AEMO National Planning to update the system strength standard in the 2023 system strength report to reflect material changes in Victoria's future needs since the 2022 ISP, before proceeding to the PADR in early 2024. This includes:

- **Declaring new system strength nodes in Victoria:** AusNet suggests a minimum of seven system strength nodes are required in Victoria, as illustrated in the figure below. The proposed Bulgana system strength node is located within the Western Victorian REZ, where the Western Victorian Transmission Network Project will unlock new generation and now proposed to connect with VNI West. The proposed Heywood system strength node is located within the South West REZ, where there is a large amount of proposed asynchronous generation, and constraints on the Victoria and South Australia interconnector.

Figure 2: Proposed location for additional Victorian system strength nodes



- **Updating minimum fault level requirements at existing declared system strength nodes.** AusNet suggests there would be value in reviewing whether existing minimum fault level requirements at Victorian declared system strength nodes are appropriate. We would expect requirements at HWTS could be lowered and still comfortably maintain power system security and reliability.
- **Updating efficient fault level requirements at existing and proposed system strength nodes.** While we accept the forecast IBR generation in the PSCR is consistent with assumptions underpinning the 2022 System Strength Report, neither document recognises that developers are planning to connect new IBR projects at a much greater scale to capitalise on the new thermal capacity unlocked by committed transmission infrastructure in Victoria. As discussed in the next section, AusNet is seeing significant interest in new generation connection in V3 - well above forecast levels. We suggest that the efficient fault level requirements are updated so that system strength services accommodate this new renewable generation efficiently and reflect developments since the 2022 ISP.

5. Alternative solutions worthy of further consideration in the PADR

The PADR should explore a more dispersed portfolio of system strength solutions that supports generation connections in renewable energy zones as generation in the Latrobe Valley is reduced

While we recognise the RIT-T is being undertaken as a reliability corrective action, it is important that the final solution efficiently meets Victoria's future energy needs over the 10 year forecast period and maximises benefits and value for money to Victorian consumers.

AusNet's preliminary analysis has investigated the merits of alternative credible solutions that meet Victoria's needs by considering a more dispersed portfolio of 250 MVA and 125 MVA of syncons than the PSCR with approximately the same total MVA capacity (i.e. seven 250 MVA syncons and three 125 MVA syncons). This includes deploying syncons at declared system strength nodes such as HWTS, MLTS, RCTS but also non-declared nodes such as Bulgana Terminal Station (BGTS) and Heywood Terminal Station (HYTS) (or Heywood to Portland corridor) over the forecast period.

Our early findings suggest a more dispersed portfolio of system strength solutions has several advantages compared to the centralised solution proposed in the PSCR. Specifically, a dispersed portfolio:

- **Has a greater ability to uplift hosting capacity in Victorian REZs, which have strong developer interest particularly after the completion of committed transmission projects.**

  The modified forecast IBR generation in the PSCR (drawn from the 2022 System Strength Report and 2022 ISP Step Change Scenario) suggests there will very limited new IBR connecting at declared system strength nodes until 2030 and as a result minimal additional fault level required to connect this IBR in this period. BGTS is not a declared system strength node and therefore no standard has been set. However, the PSCR highlights contribution of two system strength projects (Koorangie BESS and Ararat Syncon) has reduced the need for additional system strength services to support forecast new IBR in Victoria.

  As discussed earlier, the 2022 System Strength Report is outdated and does not recognise that developers are planning to connect new IBR projects at a much greater scale to capitalise on the new thermal capacity unlocked by committed transmission infrastructure in Victoria. For example, AusNet is aware of between 4,000-6,000 MW of renewable development (predominantly wind projects) planned in and around Bulgana following the completion of Western Renewables Link and VNI West, which relieves significant thermal constraints in V3.

  Many of these same developers are likely to require changes to the existing shared network (e.g. new terminal stations) to facilitate a new IBR connection regardless of other developments in play. This also unlocks further capacity for other parties to connect (or the same developer to add further IBR facilities).

  While committed transmission projects and developer led shared network augmentations provide the thermal capacity for generation to connect, there is insufficient system strength to fully utilise the available capacity. This connection limitation can be overcome through additional system strength services at the point of generation connection. However, the most efficient approach would be to connect syncons at a renewable hub within the V3 REZ that enables multiple generation projects to connect.

  Our preliminary analysis suggests a more dispersed portfolio of syncons could support approximately 3,500 MW of new IBR in V3 following the completion of WRL. By comparison, the proposed equivalent network solution in the PSCR makes no investment at BGTS and supports approximately 1,600 MW of new IBR in V3 following the completion of WRL.

- **Creates option value to make further investment in MLTS and HWTS later rather than upfront.**

  As noted in the previous sub-section, the proposed equivalent network solution increases fault levels beyond existing levels and well above minimum requirements at Heywood and Moorabool in a period where there is significant uncertainty around need for the quantum of system strength services at these nodes. Making this investment decision today incurs a sunk cost borne by consumers regardless of potential market or reliability benefits of making a different investment over the forecast period.

  There are likely to be benefits in creating 'option value' by pursuing a dispersed portfolio of system strength solutions that meets the minimum requirements at these nodes. This approach provides the flexibility for the SSSP to deploy further investment at these nodes when there is greater certainty that it is required (i.e. staged investment).

- **Better resolves issues with undertaking planned outages by more evenly distributing system strength across the Victorian network.** This is because evenly distributing system strength across the Victorian network minimises impedance between where the system strength service is located and where it is required. This can help keep existing generation online and avoid a disturbance causing a large fall in system strength during a planned

outage. We anticipate this would be particularly beneficial given there are few declared system strength nodes in areas of the Victorian network that are least likely to receive outage approval – see Figure 1.

Our preliminary analysis also found that a 125 MVA syncon at Red Cliffs 66kV was sufficient to manage minimum post-contingency fault levels, where the critical contingency at this declared node was the loss of the Red Cliffs to Kiamal 220 kV line (i.e. loss of the Kiamal syncon). We note there is limited anticipated growth in renewables at RCTS due to the inability to connect into the RCTS 220kV terminal station.

AusNet strongly encourages the PADR to investigate a similar set of dispersed credible solutions as part of the PADR's cost benefit analysis. We would be happy to share further information with AVP about the credible solutions we have investigated and assumptions underpinning our early findings.

The PADR should consider high benefit network reinforcement solutions, which can be delivered in a similar timeframe to non-network solutions.

AusNet has identified four network reinforcement solutions worth considering as part of the portfolio of solutions to meet the system strength standard. Preliminary analysis suggests these solutions can be delivered within similar timeframes to non-network solutions (i.e. within 2-3 years). They may also offer a wider range of market and essential system service benefits in both system normal and post-contingency compared to non-network alternatives. They are:

- **A 3rd 500/220kV 1000MVA Transformer at MLTS.** This solution significantly increases the system normal and post contingency fault level at MLTS 220 kV. The network capacity to supply load or charge batteries at MLTS is also increased. The solution also shifts supply flow off the existing 220 kV MLTS-GTS-DPTS-KTS corridor onto the 500 kV MLTS-SYTS corridor during periods of high wind production in V4.
- **A 4th 330/220kV 340MVA Transformer at Dederang Terminal Station (DDTS)**. This solution increases the system normal and post contingency fault level at DDTS 220kV. The network capacity to export renewable generation from the Central North REZ is also increased. This is because the solution creates additional capacity for 220 kV connected generation to inject into the 330 kV network to access both Snowy 2.0 storage and supply Melbourne demand.
- **Turning in the HYTS-MOPS 500kV circuit at TRTS 500kV**. This solution supports existing generation connected to TRTS 132 kV. Turning in the circuits increases the system normal fault level and leads to improved utilisation of the HYTS-MOPS line. We also expect post contingency voltage profiles to improve at TRTS.
- **Turning in the MOPS-CRTS 500kV circuit at HGTS 500kV.** This solution supports existing generation connected to HGTS 132. Turning in of the circuit increases the fault level at HGTS 132 kV and leads to improved utilisation of the MOPS-CRTS 500kV line. We also expect post contingency voltage profiles to improve at HGTS.

Again, AusNet encourages the PADR to consider these network reinforcement solutions and would be happy to share further information supporting our early findings.

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