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Department of Environment, Land, Water and Planning (DELWP)
State Government of Victoria
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Dear DELWP

RE: Voltage Management in the Distribution Network - Consultation Paper

SwitchDin is an Australian energy software company that bridges the gap between energy companies, equipment manufacturers and energy end users to better integrate and manage energy resources on the grid. SwitchDin's technology enables our clients to build and operate vendor-neutral virtual power plants and microgrids, and to optimise performance across fleets of diverse assets. Founded in Newcastle NSW in 2014, SwitchDin now operates in all states of Australia with early successes in Europe and emerging opportunities in the Americas and Asia.

SwitchDin welcomes the opportunity to provide feedback on DELWP's consultation paper on Voltage Management in the Distribution Network. Voltage management is instrumental in increasing the capability to host large amounts of distributed energy resources (DER) on the distribution network and importantly, well controlled and coordinated DER has the potential to significantly increase the hosting capacity of DER within distribution networks. SwitchDin is actively working in this area and through multiple projects is receiving dynamic operating envelopes, optimising customer assets within those constraints, as well as ensuring dispatch of assets for energy or network services is constrained within these envelopes. Our comments on selected consultation questions are included below.

1. ***How have current distributor voltage reporting requirements been useful since their introduction? How could these requirements be updated to provide more meaningful data for consumers and useful information to support public transparency?***

The publication of average voltage data by Victorian distribution businesses within their Distribution Annual Planning Reports is a useful first step however the resolution is very coarse limiting useability. Currently only seasonal averaged data for 4am - 10am (morning), 10am - 4pm (peak solar), 4pm - 10pm (peak demand) and 10pm - 4am (off peak) is required to be published. Expanding this to require higher resolution data, such as monthly average data by hour, would provide a much more useful dataset. In addition, publication of statistical metrics such as max, min, standard deviation, P1, P99 and their associated durations would further enrich the dataset.

2. ***Can third-parties who wish to provide non-network solutions (such as neighbourhood batteries and electric vehicle chargers) currently access voltage data to support their needs? Is there other data and information from distributors that could cover this need? Are there any privacy issues associated with sharing this data and if so, how can they be managed?***

As per our response to question 1, increasing the granularity of the published voltage data would greatly improve the usefulness of the data for planning purposes when exploring non-network solutions such as suitably controlled neighbourhood batteries and EV chargers.

Where sophisticated metering and measuring equipment is currently installed by distribution businesses it would be useful to publish where this data is available, and make this data available on request. High resolution, time synchronised distribution voltage phasor data is not only potentially useful for third-party providers but is also invaluable for research. For example, such datasets potentially support data-driven research on (1) real-time phase and topology identification, (2) load dynamics and their impact on grid stability, and (3) DER control and coordination approaches that provide direct voltage support on distribution networks and improve voltage stability margins.

In the future, access to real time, time synchronised high resolution distribution level voltage data may allow DER to be coordinated so as to react directly to local voltage conditions to support the distribution network voltage if suitably rewarded. SwitchDin is developing DER control products to address these voltage issues. Bringing forward access to such high quality data in select locations would allow acceleration of the research and development effort and understanding of practical applications in these areas.

Other data from distributors that potentially enables third parties to identify and address voltage issues, by way of non-network solutions, includes impedance and grid topology models, legacy tap-changing transformer operational (control) schemes, network model validation data and publishing of the real-time switched state of the network.

3. Do you have any comments about the analysis presented on voltage levels in Victoria's distribution networks? What further evidence or investigations should be considered to understand the voltage in Victoria's distribution networks?

The change in nominal voltage from 240V to 230V in the early 2000s appears to have not been realised in practice as the average voltage in Victoria in 2021 still remained high at 242V. There is no requirement for the average voltage to be centred around the nominal voltage of 230V and the unequal soft-limit bands of between +10% (253V) and -6% (216V) provide little incentive for distributors to bring the average voltage closer to the nominal voltage.

The imbalance of the soft-limit bands should be phased out to encourage operation centred around 230V. Lowering the average voltage toward the nominal voltage would allow more headroom for DER to export during times of peak solar generation. A challenge to doing this is lack of visibility of downstream grid voltages, and if under voltage conditions arise. Greater instrumentation to observe grid voltages across a feeder/distributor would bring confidence to utilities in adjusting the transformer taps.

4. How could regulatory arrangements for voltage management be enhanced to accommodate high levels of DER and new technologies such as electric vehicles and batteries and deliver better value for consumers?

High levels of DER lead to higher variability in distribution voltage where DER is uncontrolled - with voltage rising at times of peak solar and dropping at times of peak demand/charging. While customer behaviour and level of hardware investment (PV, batteries) can be influenced by time of use tariffs (where the distribution tariff structure is mirrored by retailers), this doesn't provide the guaranteed response required to maintain voltages within the required limits and ignores the very localised/time specific conditions that affect distribution voltage. With no other control and/or coordination, electric vehicle charging will likely further exacerbate distribution voltage issues.

While high levels of uncontrolled DER can result in over-voltage conditions (and as a worse case scenario, voltage instability), well controlled DER has the ability to actively improve the management of distribution voltage issues through controlled charging/discharging of real and reactive power, load shifting and PV export management. The full potential of this will likely only be realised when there is a price signal that directly rewards consumers for providing voltage management services.

Potential actions to safely manage voltage as DER penetration increases vary in complexity:

- **Static network connection constraints**, such as limiting installation capacity of new PV systems to a set kW rating, can be easily imposed at time of investment, but are a significant disincentive for further DER take-up, are inequitable, and unnecessarily limit the amount of DER that can be hosted within the network.

- **Dynamic operating envelopes (DOEs)**, are an emerging network control modality which provides flexible constraints only at certain times and during extreme conditions, thereby enabling networks to relax static network constraints so as to reduce loss of customer value whilst still protecting the grid. DOEs are applied automatically and there is typically no financial reward when export is limited. At present DOEs have been applied only to solar PV customers to limit site export for a small percentage of time over the year, however as DER penetration reaches higher levels, limits on both demand and export would be reached more frequently. To realise the full benefits of DOEs, customers will need both flexible loads and solar PV to ensure they can comply. This will require incentivisation and engagement with the DER OEMs and customers to effect this transition. Also, if incorrectly implemented DOEs can be an inefficient method of managing voltage unless there is a careful consideration of how available import/export capacity is shared between consumers in an affected area. The DOE approach used in Australia has to date been developed around a centralised control architecture based on a network model the state of which does not consider DER operations or location. This approach excludes the potential for local DER to cooperate with other local DER in such a way as to maximise their energy service (and value to customers) whilst minimising network issues.

- **New markets for distribution level voltage support**. To realise the full potential of DER a price signal is required to incentivise voltage support on a day to day basis rather than just as an emergency response. This would increase the DER hosting capacity of a distribution network, improve network efficiency and provide an additional value stream to improve the business case for household or distribution level batteries, which in turn would increase storage within the network and improve voltage stability margins. There are many options for how this could be implemented and this could ultimately enable DER to be rewarded for direct action in response to local real-time voltage fluctuations, and for solutions which improve local DER cooperation, in a similar way that FCAS provides automated frequency response.

5. What levers would support greater accountability for distribution businesses to deliver investments for network voltage?

DIstribution businesses should be required to consider non-network investments as an alternative to network investments for network voltage remediation which take into account individual behind-the-meter customer value from DER. For example, suitably controlled batteries positioned across distribution circuits or at a distribution substation, or programs which seek to coordinate behind-the-meter DER to actively influence network voltage while also providing the benefits for customers. If new market(s) were introduced for distribution level voltage support (as per our response to question 4) then the annual total expenditure in these markets could be compared to the alternative cost of network investment and provide greater accountability on when new network investment is more efficient than increasing spend on network voltage management.

6. ***What is the role of energy users in providing services to manage network voltages and how can others, such as aggregators, operationalise this? What opportunities are there to ensure energy users and others are fairly compensated for delivering network voltage support?***

As per our response to question 4, there is a huge opportunity for DER to be actively managed to provide minute to minute voltage support on distribution networks. This would include optimising DOE allocation strategies to preserve consumer value, co-optimisation of DOE and behind-the-meter DER, and spatio-temporal cooperation of DER to deliver advanced network services, all connected via new local network services market(s) mechanisms and incentives to reward consumers fairly for the response that they provide.

10. ***How can the objective of voltage management which maximises consumer benefits in the high DER future be balanced with the need to ensure network investment is prudent and efficient?***

As per our response to question 5, rewarding consumers fairly for day to day voltage support through new market(s) would also provide a framework to assess the cost and benefit of accessing voltage support through actively managed DER against the cost of network investment.

12. ***What are your views on the risks and benefits of going beyond compliance? What other risks and benefits should be considered?***

Going beyond compliance gives the opportunity to unleash the full potential of DER in actively managing distribution voltage, increasing DER hosting capacity and giving distribution networks a chance to prepare for operation in a high DER penetration future. Any reliance on static grid interaction limits via a compliance mechanism will introduce inefficiencies and reduce consumer value.

13. ***Is pursuing policy and regulatory reform to improve voltage management beyond compliance a worthwhile exercise? If yes, which options in Figure 15 are most worthwhile pursuing further that have a low potential to increase consumer electricity bills from upgrading the network? What other options should be considered?***

Yes, we believe that pursuing policy and regulatory reform beyond compliance is worthwhile and is an essential part of transitioning to a distributed system which fully realises the value of cooperative and co-optimised DER. The correct incentive and market structures combined with a cooperative approach to control have the potential to realise a win-win scenario for DNSPs and DER asset owners.

We thank DELWP for the opportunity to provide feedback to this process.

Best regards,

Andrew Mears
Chief Executive Officer