Electricity Distribution Code Review

Issues Paper

13 August 2019

An appropriate citation for this paper is:

Essential Services Commission 2019, Electricity Distribution Code Review: Issues Paper, 13 August

On 26 August 2019, we made a small amendment to this issues paper to reflect more accurate information on the connections project.

Contents

Summary

We are an independent regulator that promotes the long-term interests of Victorian consumers with respect to the price, quality and reliability of essential services. We regulate Victoria's energy, water and transport sectors, administer the rate-capping system for the local government sector and regulate the Victorian Energy Upgrades program.

This paper aims to outline key issues we are considering as part of our review of the Electricity Distribution Code. Interested parties are invited to submit their feedback on this paper by Monday, 9 September 2019.

In December 2018, a range of different stakeholders attended a forum hosted by the commission to contribute and inform us of their areas of interest regarding the code. Following these feedback, we published an approach paper in April 2019, drawing out the areas of focus this review seeks to cover throughout 2019-20. This issues paper further explores these topics regarding the code.

What is the Electricity Distribution Code?

The code sets minimum service standards for the distribution networks that tries to promote system security and provide a level of service protections for Victorian customers. The code covers areas such as:

- protections for customers, such as when customers can be compensated for low reliability
- technical standards that govern the way electricity is supplied
- communication requirements, such as when distribution businesses are to contact customers before a planned outage
- certain process requirements, like new customer or generator connections.

The code forms one part of the regulatory framework supporting the development, management and operation of Victoria's electricity network.

Appendix A provides further information on our role and the purpose of the code.

Our review focuses on technical and customer service standards

With the increasing customer take up of solar power and the advent of micro-grids and aggregation models, our energy system is rapidly changing and offering customers greater choices in how they purchase and are supplied energy. However, we are mindful of ensuring our regulatory framework supports the operation of these technologies and business models in a manner that supports grid stability and customer safety – it should also not create needless barriers to the connection of these new energy technologies and services in providing benefits to Victorian customers.

We recognise the changes facing the electricity industry and aim to review the code so that it remains fit for purpose for the long-term interests of Victorian customers.

In 2019-20, the review of the Electricity Distribution Code will focus on:

- technical standards with attention towards voltage and other technical standard harmonisation
- customer service standards around the communication of outages and the Guaranteed Service Level scheme
- information exchange between distributors and customers and how these may promote good business practices for customers, and
- clarifying and updating the code.

These focus areas will be split over two phases over the coming year. The first phase will primarily be on the technical standards followed by the next phase, which reviews the customer service standards set out in the code. This will result in amendments to the code where appropriate.

From 2020-21, we will continue our wider review of the code to address any remaining matters that arise, but remain unresolved this year. It will also consider the emergence of any further business models or new technologies that may create inconsistencies with the code.

Related work

We are also working on other aspects of our distribution framework, including reviewing life support requirements for distributors and connection processes for new sites. These matters are being progressed outside of the code review.

You can view more information on these projects at:

Life support:

https://www.esc.vic.gov.au/electricity-and-gas/inquiries-studies-and-reviews/strengthening-protections-life-support-customers

Electricity connections:

https://www.esc.vic.gov.au/electricity-and-gas/inquiries-studies-and-reviews/electricity-connections-process-review-2018

How to send us your feedback to this issues paper

View our ‘Issue paper questions’ chapter for some suggested questions you can use to inform your submission.

Engage Victoria

We invite written submissions on this paper by **Monday, 9 September 2019** through Engage Victoria. To view our Engage Victoria page and information on how to make a submission, please visit Engage Victoria at:

Website: https://engage.vic.gov.au/

General enquires

If you have other general enquires or wish to discuss before submitting a written submission regarding this paper, you can contact us by:

Phone: (03) 9032 1300

Fax: (03) 9032 1303

Email: edc.review@esc.vic.gov.au

Website: https://www.esc.vic.gov.au/

Post: Attention: Energy division
Essential Services Commission
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Melbourne Vic 3000

Issues paper questions

We are seeking submissions on the questions set out below. You are welcome to comment on matters we have not raised, if you think there are things we should review that we have not mentioned here.

Each chapter in this paper also includes a summary of the questions most relevant to the issues discussed in that chapter. These have been gathered here.

Customer service standards – Communication of potential outages	
Notifying customers during an unplanned power outage	1. Should we set an obligation on distributors to proactively contact vulnerable (such as life support) customers before a potential unplanned outage? 2. How should we update the current obligation on distributors informing government departments of unplanned long outages?
Customer service standards – Communication of planned outages	
Notifying customers of planned power outages	3. What form of notification or engagement should be provided to customers by electricity distributors before a planned outage? 4. Should we impose a new obligation to notify customers of a cancelled or rescheduled planned outage?
Customer Service standards – Guaranteed service level scheme	
Purpose of the guaranteed service level scheme	5. Should the purpose of the scheme be redirected to address poor service or something else altogether? 6. Are there other ways we should think about improving service levels for the worst parts of the network in the code?
Guaranteed service level categories	7. Is each payment category still fit-for-purpose in meeting the overall purpose of the guaranteed service level

	scheme? 8. Should customers receive a low reliability payment and a restoration payment? 9. Are there new categories that we should consider including in the scheme?
Worst served customer principle	10. Should we change our principle of worst served customer to capture systemic poor performance?
guaranteed service level exclusions	11. Are there any outage scenarios we should include or exclude from the scheme?
Timeliness of payments	12. Should we impose timeframes for guaranteed service level scheme payments?
Technical standards – Voltage standards	
Voltage standard	13. Should the commission review the distributor's voltage standards in the way distributors should manage voltage? In particular, we are seeking stakeholder feedback on the potential options for reviewing voltage standards, such as considering a 'best endeavours' approach or adapting the industry-recognised Australian Standard (AS 61000.3.100) for voltage management? 14. What are the appropriate customer protections relating to voltage management that we should consider? In particular, we welcome stakeholder feedback on how any changes to voltage standards might interact with Electricity Industry Guideline 11 – Voltage variation compensation.
Technical standards – Supply frequency	
Frequency management in micro-grid and Stand –alone power systems	15. Is there a need to consider the management of frequency in micro-grids and stand-alone power systems? And is it appropriate for these standards to be considered in the Electricity Distribution Code?

Technical standards – Minimum technical requirement for embedded generation	
Specific requirements for synchronous generators	16. Should we consider expanding the existing standards to capture all embedded generation technology?
Aggregation and other models	17. Aggregation is a new and evolving model in the energy landscape. What matters should we be taking into consideration? Are there other matters we should be taking into consideration for this topic?
Register of embedded generation	18. Should we retire our register and harmonise by requiring distributors to comply with the national register only? What may be the potential benefits or issues with retiring our register?
Technical standards – Other technical regulations	
Power factor	19. Should we review the power factor range and consider alignment with industry practices?
Harmonics	20. Should we consider harmonising with the National Electricity Rule and adapt the Australian Standard (AS 61000.3.6) for harmonics? What may be the potential benefits and or issues with harmonising?
Negative Sequence	21. Should the negative sequence limits of the code be harmonised with the national limits? What may be the potential benefits and or issues with harmonising?
Other code issues	
Code definitions	22. Are there any defined terms that you think are no longer correct or relevant that we need to address? 23. Should we align as much as possible and adopt national definitions set out in Appendix I? What may be the potential benefits or issues to align with the national definitions?

Further clause clarification	24. Are there particular clauses that stakeholders think need to be made clearer?

1. Customer service standards

The Electricity Distribution Code contains protections for customers as they use and interact with the electricity network. These protections largely provide customers with information about planned or unplanned outages they may experience, or to provide business customers with sufficient information to make informed choices about their connection with the grid. The code also provides for monetary payments to be made to customers, if they experience poor levels of service from the network – this is referred to as the Guaranteed Service Level scheme.

Several independent reviews have also raised the need to consider the type and levels of customer protections in the code, and for the commission to make changes where appropriate.[1]

Questions to be considered for this chapter

If you would like to make a submission to us on issues raised in this chapter, we recommend you consider the following questions as part of your response.

Notifying customers during an unplanned power outage

1. Should we set an obligation on distributors to proactively contact vulnerable (such as life support) customers before a potential unplanned outage?
2. How should we update the current obligation on distributors informing government departments of unplanned long outages?

Notifying customers of planned power outages

3. What form of notification or engagement should be provided to customers by electricity distributors before a planned outage?
4. Should we impose a new obligation to notify customers of a cancelled or rescheduled planned outage?

Is the purpose of the guaranteed service level scheme still appropriate?

5. Should the purpose of the scheme be redirected to address poor service or something else altogether?

[1] Department of Environment, Land Water and Planning: The Post Event Review – Power outage 28 and 29 January 2018, Independent Review of Victoria's Electricity and Gas Network Safety Framework , December 2017 and Essential Service Commission - Electricity connection process review 2018

6. Are there other ways we should think about improving service levels for the worst parts of the network in the code?

Are the payment categories still appropriate for the guaranteed service level scheme?

7. Is each payment category still fit-for-purpose in meeting the overall purpose of the guaranteed service level scheme?
8. Should customers receive a low reliability payment and a restoration payment?
9. Are there new categories that we should consider including in the guaranteed service level scheme?

Who are the worst service customers?

10. Should we change our principle of worst served customer to capture systemic poor performance?

Are guaranteed service level exclusions appropriate?

11. Are there any outage scenarios we should include or exclude from the guaranteed service level scheme?

Payment timing requirements

12. Should we impose timeframes for the guaranteed service level payments?

Notifying customers during an unplanned power outage

The code requires distributors to notify certain government departments[2] if it thinks that a long sustained unplanned outage will occur at a specific location. However, there are no requirements on distributors to proactively notify customers ahead of a potential widespread event. We consider that notifying life support customers ahead of a long unplanned outage provides more time to plan how they manage their critical needs.

Notifying vulnerable customers

As part of a review into the major outage of the summer in 2017-18, relevant government departments and authorities have been working with distributors to notify vulnerable customers (such as life support customers) during emergency events that have led to widespread outages. These arrangements have not been formalised as a regulatory obligation in the code.

[2] Department of Health and Human Services Victoria

We are considering whether to establish minimum requirements for when to notify customers during an unplanned outage. This might involve establishing a threshold for when a distributor would need to notify vulnerable customers of an outage or a potential outage.

It should also be noted that the commission is separately reviewing energy retailer and distributor obligations to customers relying on life support equipment. This review will largely focus on providing for the same level of protections with vulnerable customers under the national framework. We are aiming to complete our review into life support obligations by the end of 2019.

Notifying government departments

The code requires distributors to notify relevant government departments of potential long unplanned outage. The obligation only applies if the distributors believe an outage will persist for at least 24 hours. However the current practice of distributors is to inform governments of long outages that may not reach the 24 hour threshold.

We are considering whether to change the code to align with the existing informal practices and processes that distributors currently have in place with relevant stakeholders (such as government departments or emergency authorities).

Notifying customers of planned power outages

The code sets out specific requirements on when distributors are to contact customers about a planned outage. This is to allow customers to prepare for a planned outage, so that they could organise back-up generators to continue their work or activities, or make other arrangements.

Some planned outages could be cancelled or rescheduled by distributors, despite customers being notified beforehand. When this occurs, customers may have already spent money to organise back-up generators, and these costs could have been avoided. As a result, some stakeholders have suggested that distributors should notify customers if a planned outage is cancelled or rescheduled, and we welcome further feedback from stakeholders.

We are also aware that some customers, despite receiving notifications of planned outages, have still felt they have not been effectively engaged by distributors regarding these outages. These planned outages could also be a result of proposed works on the network by another customer. We also welcome feedback from stakeholders on these situations.

Reviewing the Guaranteed Service Level scheme

The guaranteed service level scheme acknowledges the inconvenience and potential damage customers experience when their distributor does not meet service obligations set by us, and requires distributors to pay customers directly as a result.

There are currently six types of payments under the guaranteed service level scheme. Two relate to the elements of service, late attendance at appointments and delays to providing new connections. The rest relate to low reliability and restoration.

This obligation is set out under section 6 of the code, which all licensed distributors have to comply with under section 20 of the Electricity Industry Act 2000.

Is the purpose of the guaranteed service level scheme still appropriate?

The guaranteed service level scheme is designed to acknowledge the level of potential supply outage that customers may experience when a distributor does not meet its obligation of service to its customers. The scheme seeks to capture the minority of customers that experienced the worst service in the network, such as those who have experienced the most prolonged amount of annual duration outages per annum.

A brief history of the guaranteed service level scheme

The guaranteed service level scheme was put in place when the entire electricity network was operated by the State Electricity Commission of Victoria, and originally focused on appointments and connections only.

In 2001, the scheme was expanded to recognise poor reliability and was one part of the regulatory framework for distributors that the Essential Services Commission administered. During that time, the commission also reviewed and determined the price controls that distributors could charge customers, which is now the responsibility of the Australian Energy Regulator. This meant the amount paid to customers by distributors through the guaranteed service level scheme directly affected the revenue distributors could receive – also referred to as the incentive regime.

As part of our review of distribution pricing for 2006-10, we reviewed and clarified the guaranteed service level scheme consistent with five principles:

- The guaranteed service level payments for reliability should target those customers with the worst reliability.
- It may not be efficient to improve the reliability for particular customers. Where reliability is not improved, the guaranteed service level payments are an acknowledgement to these customers that this may be the case.
- Guaranteed service level payments should reflect, where possible, variations in customers' willingness to pay based on their current level of service.
- The distributors' IT systems must be able to identify the customers to whom payments are to be made and ensure that the payments are made.

- The administrative costs of the guaranteed service level payment scheme must not exceed the benefits of the scheme.

By 2015, the regulatory framework for distributors changed and the Australian Energy Regulator now had responsibility for determining the allowable revenues that distributors receive to operate their business, known as the revenue framework. However, the commission still retains the responsibility of setting service standards.

Within the current revenue framework for distributors, the Australian Energy Regulator has several incentive mechanisms relating to operating expenditure, capital expenditure, and service performance. Through its service target performance incentive scheme, the distributor is penalised or rewarded based on its performance. If the electricity distributors are able to deliver a given level of service at a lower cost, they are able to retain the additional savings and receive a revenue bonus.

This incentive regime offsets the risk that the electricity distributors will minimise investment in service to earn additional profits. But it does not directly interact with the worst served customer the way our original scheme did.[3] This has meant that our jurisdictional guaranteed service level scheme is no longer connected to a financial incentive mechanism to address the worst served. Further, the cost of the scheme is a straight pass-through to customers. This means it has no financial impact on the distributor regardless of the number of payments made.

Therefore, the current guaranteed service level scheme no longer fulfils part of the principles it was designed for (refer to blue box above). The guaranteed service level scheme continues to highlight where customers have experienced exceptionally poor service (or poor reliability or abnormal outages), but it has limitations in recognising customers experiencing systemic poor service.

Are the payment categories still appropriate for the guaranteed service level scheme?

The guaranteed service level scheme currently has six different categories of payments that worst-served customers are entitled to, as follows:

- **Timeliness of appointments.** These payments intend to hold distributors accountable to be punctual for appointments made with customers.
- **Failure to supply payment.** These payments recognise the inconvenience or potential damage when customers are without power for multiple days. For example, small businesses may be

[3] The STPIS does have a GSL component but if a jurisdiction has a GSL scheme then the AER's GSL scheme is not active and therefore does not get the incentive pressure through the STPIS.

affected as butchers need cold storage to maintain fresh meat, or builders may need an electricity connection to continue their work.

- **Low reliability.** These payments intend to acknowledge customers on the poorest quality and reliability feeders who are unlikely to ever receive service improvements due to the cost associated with improving their supply. This payment includes annual duration payments and, annual sustained and momentary frequency payments.
- **Restoration payments.** These payments are designed to recognise the inconvenience or potential damage of sustained prolonged outages experienced by customers. The payment occurs if urban or rural customers experiences 12 or 18 hours of outage from a singular event respectively. However, if the customer has received an annual duration payment (outages in a year cumulating more than 20 hours) then they will not receive a restoration payment. These payments were introduced in 2016.

Each of these payments directly relate to the service distributors provide to customers and aim to achieve part of the overall purpose of the guaranteed service level scheme. Further, each payment captures an observable part of the service that a customer can see and articulate as a part of their energy experience.[4]

Who are the worst served customers?

The guaranteed service level scheme has been designed to consider the customers who have the worst service on a distribution network. We currently consider the 'worst served customers' as the one per cent of customers who have experienced the most minutes without electricity supply over a single year. This means the worst served customer changes on an annual basis – it may not only include customers that continuously experience poor service, but also capture customers that may experience a single long sustained outage due to major events such as bad weather. This might encourage distributors to invest in areas of the network that might be reliable for most of the time, but happen to have experienced unexpected events leading to long outages.

Other regulators consider 'worst served customers' differently, often as a customer that has experienced poor performance for several years (as opposed to a single year in Victoria). The Australian Energy Regulator recently defined a worst served customer[5] as one who experienced more than four times the network average in minutes without supply for unplanned outages on a three-year rolling average. The Essential Services Commission of South Australia considers the worst served customer as one who has experienced twice the average annual unplanned minutes without supply for that region for two consecutive years.

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[4] Distributors' IT systems can record this information.

[5] Or 'inadequate level of service customer'

We welcome stakeholder views on how the commission currently considers the 'worst served customer' in the Victorian context.

Are the exclusions for distributors to make guaranteed service level payments appropriate?

There are several conditions that exclude distributors from making guaranteed service level payments. These conditions generally relate to the cause of the outage being outside a distributor's control. For example, if there is an issue on the transmission network that causes an outage, the distributor will not need to make a guaranteed service level payment, as it could not have taken reasonable measures to avoid the outage or be able to fix that outage.

Currently clause 6.3.3 of the code sets out the conditions for exclusions of guaranteed service level payments. Some conditions include planned interruptions, interruptions requested by the customer, situations where customers ask for power not to be restored during an unplanned interruption, or if the customer has planned for an interruption in order to receive assistance or repairs from their distributor.

However, the distributor can also apply to the commission for an exclusion for making a guaranteed service level payment (clause 6.3.4 of the code). The conditions of these events include load shedding due to a generation shortfall (but not because of distribution network support embedded generation), frequency triggers, a direction by the system operator, shortfall in demand response initiatives, an outage caused by the transmission network; or where the frequency of unplanned outages exceeds a particular threshold.

We note that the Australian Energy Regulator has recently reviewed the exclusions in its scheme, and we consider it appropriate to also review the conditions for exclusions under our guaranteed service level scheme. Appendix H sets out the current exclusions in our code and compares them to the exclusions set out by the Australian Energy Regulator.

Are guaranteed service level payments made to customers in a timely manner?

The code sets out the maximum time in which a payment needs to be made to a customer (clause 6.4). Under the current scheme the guaranteed service level must be paid by the distributor as soon as practicable after the obligation is triggered. For annual guaranteed service level payments, customers are to be paid as soon as practicable after 1 January of the following year of the outage. Additionally, any restoration guaranteed service level payment can only be paid after 1 January of the following year, as these payments are tied to whether the same customer will receive a low reliability payment (you cannot have both). The remaining guaranteed service level payments types could be paid at any point during the year.

We recognise that the issue above may be contrary to a customer's expectation where they may expect a payment not long after experiencing an outage. The customer frustration could worsen the relationship with the distributor on two fronts. Firstly, the time it takes for the payment and if a query is made by a customer on when the payment will come, the distributor cannot give a definite timeframe. There are clear benefits to customers by putting in measurable indicators that distributors can be held accountable for.

We welcome stakeholder feedback on the timing for when guaranteed service level payments are required to be made to customers.

Connection guaranteed service level clarification

As part of our 2006 review, we found it was unclear when guaranteed service levels should be made for connections. The reason for this is because of two conflicting clauses:

Clause 2.2 of the code specifies that a distributor must use best endeavours to connect a customer on an agreed date and if no date is agreed upon within a default of 10 business days.

However, clause 6.2 only provides a penalty for not providing a connection by the agreed date (and does not specify that it should be made within 10 business days if there were not an agreed date). Some distributors have interpreted this to mean no payment is required under the scheme if there is no explicit agreed date.

In our 2006 review, we clarified that if there was no agreed date then the payments would commence if the connection had not been made within the 10 business days required under clause 2.2. We plan to clarify this in this review.

Exempt persons and other types of networks

Embedded networks are privately owned and operated networks that supply and sell electricity to customers in properties such as apartment buildings, shopping centres, retirement villages, caravan parks and boarding houses. They purchase electricity from licensed retailers and then on-sell it to end-use customers in the private network and also perform functions similar to distributors such as the maintenance and operation of the network.

Some embedded networks currently provide network services to many electricity customers. The customers of embedded networks receive some of the same protections to customers directly connected to the distribution network. However, embedded network providers are exempt from some customer protection obligations (clause 1.3.5), such as reliability standards, providing customers with certain information, additional distribution charges and access to the guaranteed service level scheme. Some stakeholders have raised particular concerns that embedded network customers do not have access to a guaranteed service level scheme.

Under the current regulatory framework in Victoria, the gateway connection owner is considered the distribution customer. That means if there is an outage on the distribution network that effects embedded network customers, those customers do not receive any guaranteed service level payments (if applicable). Additionally, if the total size of the embedded network is less than 160 MWh per annum, only the embedded network owner will receive a direct guaranteed service level payment from its distributor.

We also recognise that the energy market is changing, and note some unique examples of exempt persons offering services to customers that intersect between the customer and the distributor.[6]

We welcome stakeholder views on how the guaranteed service level scheme could interact with embedded network customers and intend to consider this as part of our wider review of the code. We will also be interested in new services offered to customers by exempt persons, and how this might relate to the customer protections currently afforded to customers being supplied by distributors.

Delays in electricity connections timeframes

In May 2018, the Minister for Finance requested advice from the commission about whether the regulatory framework could be enhanced to facilitate more timely electricity connections. Our review primarily focused on issues related to negotiated electricity connections in greenfield areas. These connections are often negotiated between the developer and distribution business direct because they are complex and require bespoke agreements.

We advised the Victorian Government that the regulatory framework underpinning negotiated connections was not the main cause of delays in connecting new developments to the networks. Stakeholders did not raise concerns with the time taken by distribution businesses to respond to enquiries and applications and issue offers to connect. These components of the connections process are subject to regulated timeframes under Chapter 5A of the National Electricity Rules.

However, we did suggest that the effectiveness of this framework could be improved through a number of targeted measures. These measures included reviewing our codes and guidelines that interact with connections to assess whether they are consistent with one another and current industry practices and the National Electricity Rules.

Process for connecting electricity to new developments and houses

Connecting and energising a home in a new subdivision involves many participants, occurs over several stages and can take about 18 months to three years from the time an initial enquiry to connect is made by a developer to an electricity distribution business. The

[6] Pilot trials exploring how peer to peer trading system could work between customers trading solar export through an online platform.

connection process involves distribution businesses, developers, electrical designers, civil contractors, electrical cable installers, councils, builders, electricity retailers and the end use consumer.

We have identified six stages in the process to connect and energise a new development to the distribution network (also known as a negotiated connection):

1. Precinct Structure Plan and Planning Scheme
2. Service Master Plan (Network Scope Plan)
3. Network reticulation design
4. Construction management and delivery
5. Construction audit
6. Electrical 'tie-in'

This is followed by two stages of a basic or standard connection to firstly energise a home (and provide a builder with a temporary supply of electricity), and then to connect the home via an energy retailer.

Causes of the delays in connections

Our review revealed that major delays in the negotiated connection process occurred during the service master plan (stage 2), the construction audit (stage 5) and the electrical 'tie-in' (stage 6). Builders also noted delays in getting temporary connections so they could use power tools to build new homes. Stakeholders suggested the major causes of these delays were due to:

- inadequate customer focus by distribution businesses
- rapid growth in new lots constructed and resource constraints
- particular auditing practices of some distribution businesses
- declining quality of civil work including electrical installation
- the management of technical standards set for industry.

Connection service improvement commitment

We recognised the need to develop practical solutions that could be implemented relatively quickly to resolve or reduce the causes of these delays. Together with industry, we developed practical solutions that required all key stakeholders to implement and deliver – these solutions were agreed in principle by the representatives of the development industry.

We also asked distributors to agree to a service improvement commitment to:

- improve the customer service focus of distributors

- minimise avoidable delays in connecting greenfield developments to the existing distribution networks
- improve the way technical standards are managed
- improve the ways audits are performed
- promote efficient competition in connection services (or component steps), and
- encourage initiatives to increase resourcing related to new connections.

Distributors would also be part of a governance committee chaired by our Chief Executive Officer and attended by representatives of the development industry.[7] The committee oversees the delivery of the commitment and other initiatives. The minutes from these committee meetings are published regularly on our website (www.esc.vic.gov.au/electricity-and-gas-connections).

Improved performance in connection times

Since the establishment of the committee, distributors have undertaken a range of initiatives to improve connection times, including:

- improving stakeholder consultation and communications
- developing a set of key performance indicators to measure connections performance
- establishing a technical standards committee with developers and contractors and
- improving their resourcing required to undertake connections work.

Representatives of developers on the committee have recognised these actions taken by distributors, and indicate they have experienced improvements in connection times in 2019. We noted improvements in the distribution businesses connection performance in the first half of 2019, when compared to stakeholder estimates of performance over the period 2017-18.

Table A shows the key performance indicators each distribution business reported against.[8]

Table A

AusNet Services	Jemena	Powercor
Master planning review time		Master planning review time
Construction audit time		Construction audit time
Electrical tie -in		

[7] Membership: Powercor, AusNet Services, Jemena, Urban Development Institute of Australia, Property Council of Australia, Victorian Planning Authority and Essential Services Commission

[8] We note the distribution businesses have different KPIs. This reflects different priorities for distributors and developers and contractors working in different distribution zones.

Temporary connection time		Temporary connection time
	Negotiated connection offer time	
NMI allocation time		
Meter connection time		
		Reticulation design review time
		Time to provide practical completion

Although we recognise the improved connection timeframes reported by distributors and recognised by developers, we also considered formalising distributor practices as obligations in our code as part of our review.

We welcome stakeholder views on whether new or amended obligations are required in the code related to connection timeframes. We are particularly interested in what type of regulatory intervention may be required, so we can consider its effectiveness, costs and potential benefits.

2. Technical standards

The Electricity Distribution Code includes technical standards that describe the operational technical limits for the Victorian distribution network to be safely and efficiently operated for all customers. Distributors having been granted the licence to operate the distribution network, they have the primary responsibility to manage the network within these technical limits.

The topics covered in this chapter expand on the initial areas of focus highlighted in our April 19 approach paper, with a focus on the technical standards of our code. In this chapter, we describe the issues raised by stakeholders or identified relating to the technical standards in the code.

We are seeking stakeholder feedback on the issues we have raised in this chapter, and the following questions can help guide your submissions to us.

Questions for stakeholders

Voltage standard

13. Should the commission review the distributor's voltage standards in the way distributors should manage voltage? In particular, we are seeking stakeholder feedback on the potential options for reviewing voltage standards, such as considering a 'best endeavours' approach or adapting the industry-recognised Australian Standard (AS 61000.3.100) for voltage management?
14. What are the appropriate customer protections relating to voltage management that we should consider? In particular, we welcome stakeholder feedback on how any changes to voltage standards might interact with Electricity Industry Guideline 11 – Voltage variation compensation.

Frequency management in micro-grids and stand-alone power systems

15. Is there a need to consider the management of frequency in micro-grids and stand-alone power systems? Is it appropriate for these standards to be included in the Electricity Distribution Code?

Specific requirements for synchronous generators

16. Should we consider expanding the existing standards to capture all embedded generation technology?

Aggregation and other models

17. Aggregation is a new and evolving model in the energy landscape. What matters should we be taking into consideration? Are there other matters we should be taking into consideration for this topic?

Register of embedded generation

18. Should we retire our register and harmonise by requiring distributors to comply with the national register only? What may be the potential benefits or issues with retiring our register?

Power factor

19. Should we review the power factor range and consider alignment with industry practices?

Harmonics

20. Should we consider harmonising with the National Electricity Rule and adapt the Australian Standard (AS 61000.3.6) for harmonics? What may be the potential benefits and or issues with harmonising?

Negative sequence

21. Should the negative sequence limits of the code be harmonised with the national limits? What may be the potential benefits and or issues with harmonising?

Voltage standards

The code sets technical standards for distributors. These standards regulate the supply arrangements between customers and distributors to achieve a safe and sustainable electricity grid. This includes setting and managing voltage levels within the network.

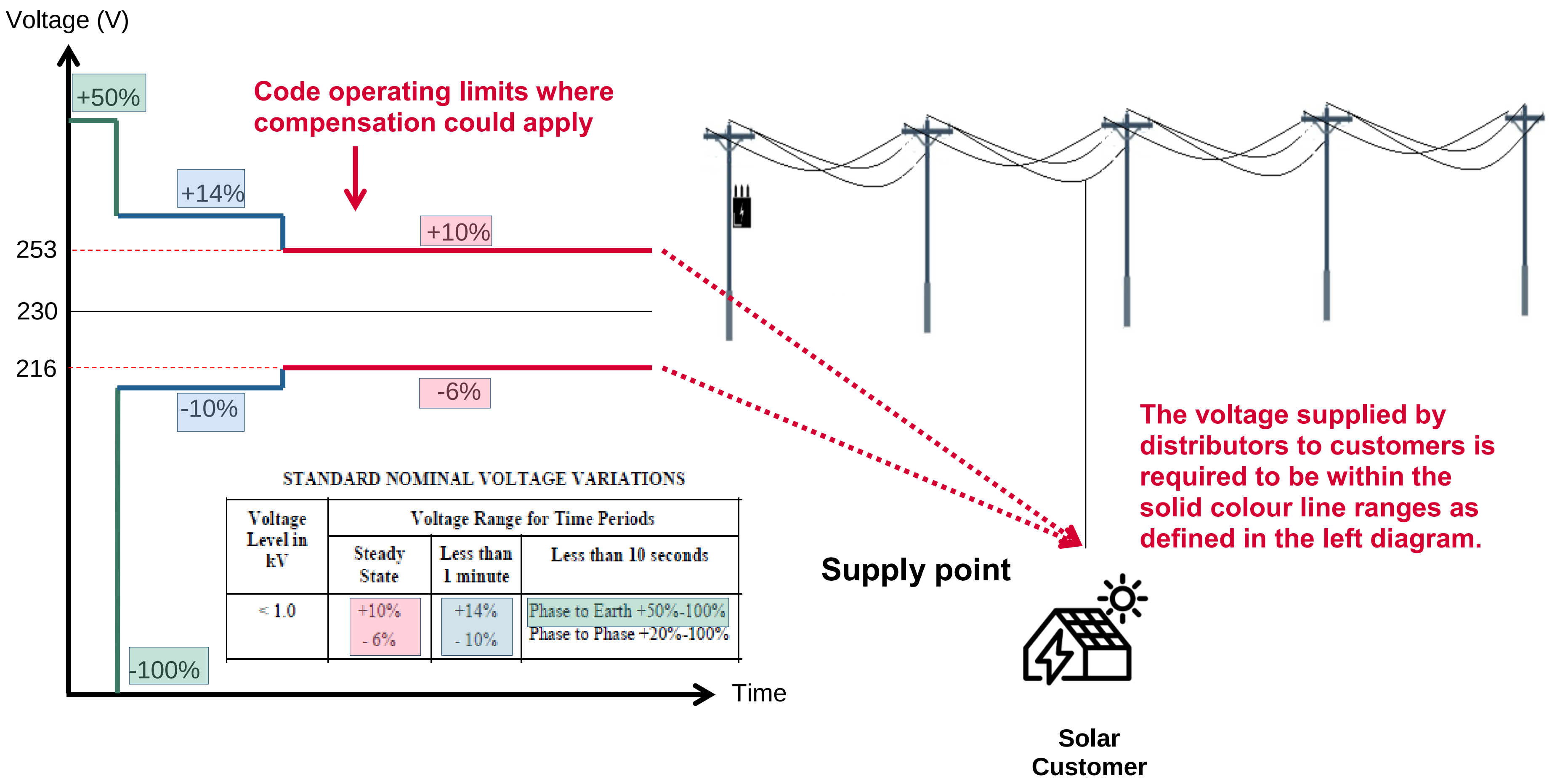
> **Voltage** is a characteristic of electricity and by extension the power system. A useful analogy to think of voltage is water pressure in pipes. Pressure is necessary for water to flow through the pipes. The higher the pressure, the faster it flows. Similarly, voltage could be thought of as the electrical pressure for the power system. Too high or not enough voltage could lead to equipment malfunction.

The code currently requires distributors to regulate voltage within a certain range. For low voltage, distributors are required to manage the supply voltage ideally at the 230V level to customers during normal operation. It is not always practical to manage voltage at 230V, therefore our code allows the voltage to vary 10 per cent above (253V) and 6 per cent below (216V) from the ideal 230V level.[9]

Figure 1 illustrates how the low voltage parameters of our standard apply to distributors for customers, set out as clause 4.2.2 of the code. Under steady state conditions (or normal, business-as-usual conditions), distributors are to manage voltage within a fixed limit. This is not the case for non-steady state conditions, such as periods of less than 1 minute or 10 seconds, where distributors are only required to use its best endeavours to manage voltage within limits – this is for abnormal conditions where voltage fluctuations may not instantly be controllable.

[9] Electricity Distribution Code, clause 4.2.2, Table 1

Figure 1– Electricity distribution code voltage standards



Voltage Level in kV	Voltage Range for Time Periods		
	Steady State	Less than 1 minute	Less than 10 seconds
< 1.0	+10% - 6%	+14% - 10%	Phase to Earth +50%-100% Phase to Phase +20%-100%

Not to scale

Distributed energy resources and voltage standards

Victoria's electricity network is changing, with an increasing volume of distributed energy resources including solar generators and batteries being installed across the networks. This change creates opportunities for the management of our network, including the ability to better manage demand in peak periods. It also creates challenges, such as managing voltage within the levels prescribed by our code, which industry projects are exploring.[10]

In a system wide context, Australian Energy Market Operator has also identified challenges in operating the national power system with a large number of small-scale solar generators interacting with the grid than what was envisioned more than a decade ago. A particular challenge is the way solar generators interact with the voltage experienced in the local distribution network. When local voltage exceeds a certain range, there is potential for solar generators detecting this to temporarily shut-down as a means of protecting itself from damage. This potential scenario presents a challenge for operating the system.[11]

We are open to reviewing our voltage standards to support how customers are connecting and using the grid, however, we note the following considerations:

- industry has been moving to voltage standards that allow more flexibility than what is set out in our code (which sets strict limits on voltage) and
- changes to the voltage standards can affect other protections for customers, such as receiving financial payments for damage to their equipment as a result of too high or low voltage.

These considerations are described further in the following sections.

Flexible voltage standards

A draft proposal by a distributor[12] has highlighted their future investment projections in the area of distributed energy resources. Although this does not represent all distributors, it provided a glimpse of where other distributors may potentially seek other similar enabling investment. These investments may potentially better facilitate the increasing take up of technologies such as solar generators and, at the same time, assist in managing voltage.

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[10] Networks renewed, ARENA, https://arena.gov.au/projects/networks-renewed/

[11] Technical integration of distributed energy resources, April 2019, page 4, AEMO, https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/DER-program/Improving-DER-Capability

[12] Deep dive workshop – background materials and reports, Ausnet Services, https://www.ausnetservices.com.au/en/Misc-Pages/Links/About-Us/Charges-and-revenues/Electricity-distribution-network/EDPR-2021_25

Distributors may be considering such investment to comply with the fixed voltage limits currently set out in our code. For example, this could be done by installing new network equipment, reconfiguring the network or adding smart systems to assist in the operation of the network.

Alternatively, we could consider other measures such as optimising the voltage standards to enable more flexibility for distributors, as opposed to investing in upgrading the network. This could be through changing our fixed limits for voltage standards into a ‘best endeavours’ standard, or adopting industry recognised Australian standards. Greater flexibility in the code may allow for more uptake and installation of distributed energy resources such as solar generators on the grid.

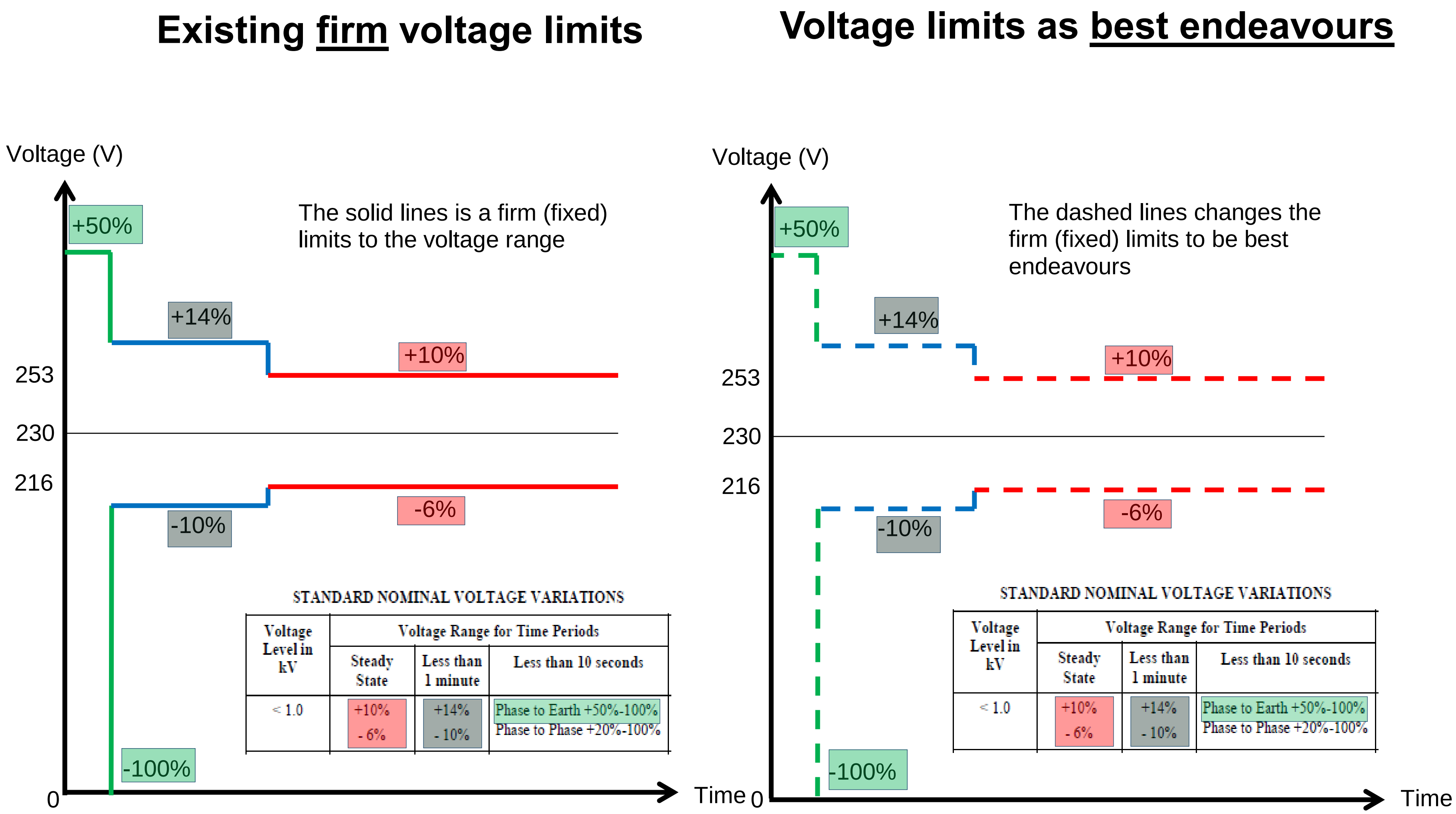
A ‘best endeavours’ voltage standard

Under this approach, distributors would need to use their ‘best endeavours’ to manage voltage within limits. This is opposed to having to strictly manage voltage within set limits under normal conditions (steady state conditions).

Under a best endeavours voltage standard, distributors can better manage voltage while reducing the potential need for significant investment in the network. Although the best endeavours may allow for the range to be exceeded, it does not diminish the responsibility of distributors to manage this to be within reasonable limits in accordance with industry best practice.

Figure 2 illustrates an example of how a best endeavour approach could be applied to the existing voltage parameters of our code.

Figure 2 – Comparison between Electricity Distribution Code firm limits and best endeavours



Not to scale

The industry-recognised Australian Standard for voltage

We are aware of other jurisdictions or organisations that have adopted (or are in the process of adopting) the Australian Standard (AS 61000.3.100) for voltage.[13] This takes a different approach on how voltage variation should be managed, by applying a statistical distribution to voltage variation.

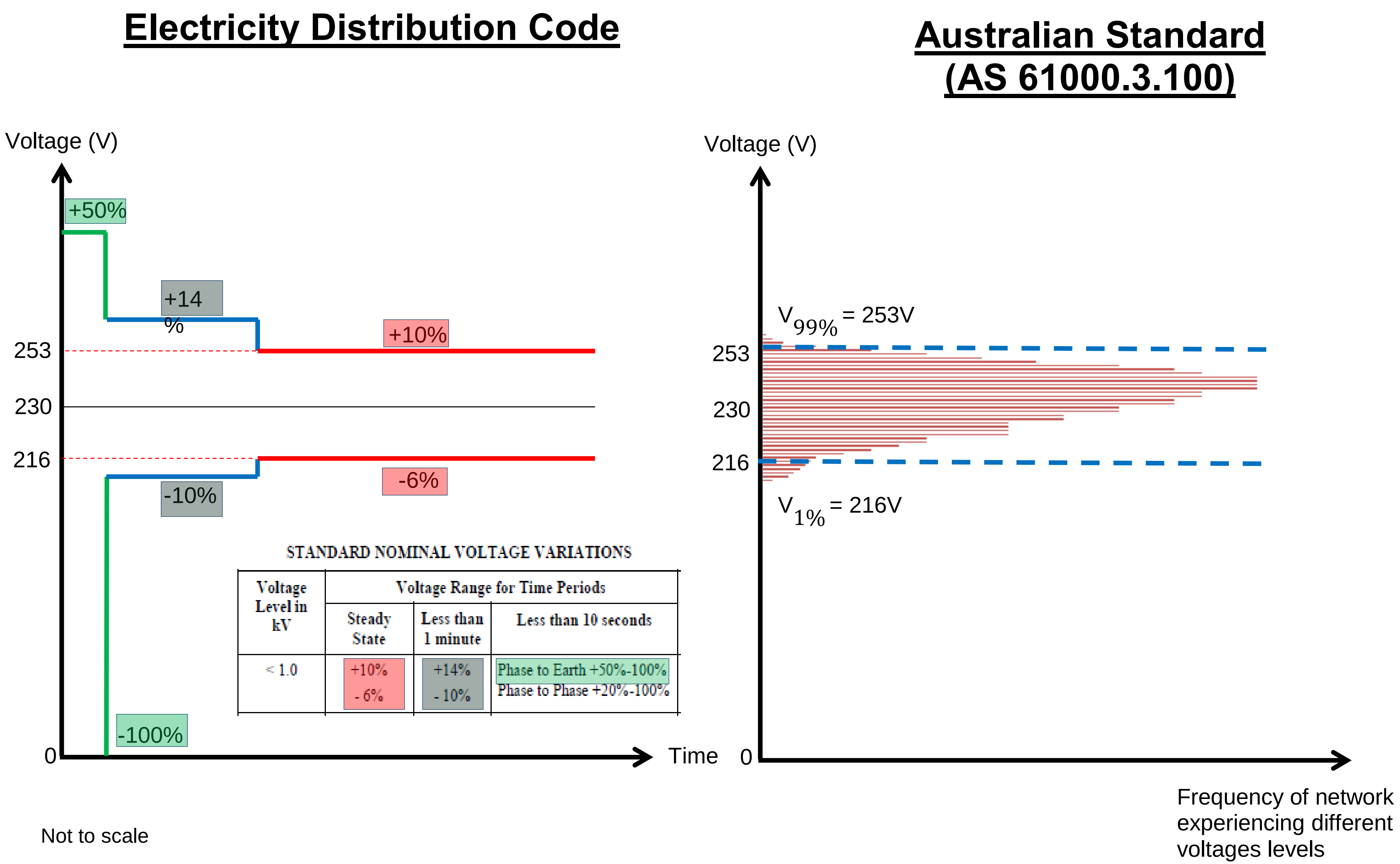
This statistical approach requires distributors to operate within a similar voltage range to our code 99 per cent of the time. However, for 1 per cent of the time, distributors may deviate outside the defined limit without being non-compliant. This approach gives the most flexibility for distributors to respond to the variations in voltage. However, the commission will need to consider how to monitor or promote distributors to manage voltage such that these effects are minimised for customers during the 1 per cent time period.

Figure 3 illustrates the statistical approach set out by the Australian Standard compared to the current standards of our code.

We invite stakeholders to comment on the potential approaches to the code's voltage standards within the context of our changing energy grid. In particular, what opportunities and challenges may arise if the commission changes the voltage framework to promote greater flexibility in voltage management?

[13] SA, NSW have adapted and QLD are in the process

Figure 3 – Comparison of the Electricity Distribution Code and the Australian Standard (AS 61000.3.100) voltage standards



STANDARD NOMINAL VOLTAGE VARIATIONS

Voltage Level in kV	Voltage Range for Time Periods		
	Steady State	Less than 1 minute	Less than 10 seconds
< 1.0	+10% - 6%	+14% - 10%	Phase to Earth +50%-100% Phase to Phase +20%-100%

Voltage standards and customer protections

Related to our code is a separate guideline that the commission administers, known as Electricity Industry Guideline 11 – Voltage variation compensation, which provides a complementary set of protections for customers.

The guideline allows for a capped payment to be made to customers if their equipment or property is damaged as a result of excessive voltage. Excessive voltage is when voltage deviates either higher or lower from the fixed limits set out in the code.

We are conscious that allowing greater flexibility with our voltage standards could affect the way customers are paid in the event damage occurs caused by excessive voltage. This is because the eligibility for payment is linked directly with the fixed voltage limits of the code. In NSW, IPART[14] has suggested introducing a similar protection to our voltage variation compensation guideline, where the Australian Standard to voltage management is in effect for their distributors.[15]

We are open to stakeholder views on how to consider both our voltage standards and relevant customer protections as the operation of the network changes.

Monitoring

Distribution network businesses are required to monitor the quality of supply under the code.[16] With the introduction of smart meters across the distribution system, distributors are able to receive technical data for an individual customer. This data could be further utilised by distributors to enhance how it monitors the networks, and the information it provides to customers and the broader industry. For example, distributors could potentially make available information on voltage performance at a more local level.

We welcome stakeholder views on how smart meter data could be used to enhance distributor monitoring, and potentially provide further benefits.

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[14] Independent Pricing and Regulatory Tribunal – provides independent regulatory decisions and advice to protect and promote the ongoing interests of the consumer, taxpayers, and citizen of NSW.

[15] IPART – Submission on AER draft amended service target performance incentive scheme – 9 February 2018, p3, https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/service-target-performance-incentive-scheme-2018-amendment/draft-decision

[16] Electricity Distribution Code, Clause 4.2.6 and clause 4.9. Zone substation can be considered as a staging system used by distributors where bulk power is transformed into more usable format to then be distributed more efficiently and converted once more to low voltage suitable for customer level use.

Feeder is a high voltage electricity power supply used to transfer some of the bulk power from the zone substation along a designated geographic route to supply the customers along that corridor.

Voltage ranges and the operation of bushfire mitigation equipment

In August 2018, we made a final decision to change the voltage standards applicable for the 22kV distribution system. This was to enable the introduction and operation of bushfire mitigation technology known as Rapid Earth Fault Current Limiters.

Since our final decision last year, some stakeholders have commented on the impulse voltage rating (150kV) of our code being different from the latest equipment standards. We note that throughout our consultation process, the submissions received did not indicate this being a specific issue, noting that Energy Safety Victoria also did not raise impulse voltage ratings as a concern.[17]

Our 2018 decision paper concluded that direct negotiation between distributors and customers allows for the most efficient solution to be agreed on between both parties. It should also be noted that the code has always included a clause[18] that provides for negotiation between distributors and customers, allowing for conditions that are bilaterally agreed and more appropriate than network-wide standards set out in the code. We invite stakeholder views on this matter.

Supply frequency

Frequency

Supply frequency is an operating characteristic of the power system, and results from the physical spinning of electricity generators. The management of frequency is necessary for the safe, stable and secure delivery of electricity to customers. If frequency becomes too high or low, equipment connected to the network may stop working. In very unusual circumstances, unstable frequency could also lead to system wide instability and malfunction.

Frequency must be maintained within certain levels across the entire National Electricity Market, which includes the five electricity networks in Victoria. Managing this requires a central and holistic approach to coordinate, schedule and dispatch electricity generators to be balanced with customer load. The Australian Energy Market Operator currently manages the dispatch of electricity generation to manage system frequency across the national electricity system.[19] Therefore, our

[17] Energy Safe Victoria submission: Electricity Distribution Code – Review of voltage standards for bushfire mitigation – draft decision, 12 June 2018, p7

[18] Electricity Distribution Code, Clause 1.6

[19] Nation Electricity Rules, section 4.4.1

code makes it clear that Victorian distributors do not have an obligation to manage frequency in its networks.[20]

Frequency management in micro-grids and stand-alone power systems

There may be specific circumstances where independent frequency management is required outside of remit of the Australian Energy Market Operator or the distributors. This is particularly the case where a small part of the networks disconnects from the wider electricity network either temporarily or permanently. This could involve a household battery storage system, micro-grids[21] or stand-alone power systems.[22] When these smaller networks disconnect from the wider grid, under the existing regulatory framework, the energy market operator and Victorian distributors have no obligation to manage frequency within these separated smaller networks.

Micro-grids

For the purposes of this paper, we have defined micro-grids as follows:

- A private power system consisting of individual or localised group of electricity generators, with some form of power distribution system and some form of commercial interaction with customers (such as energy billing, contracts or retailing).
- The boundaries of the micro-grid are contained within a small geographical area, individual facility or even an individual premise.[23]
- A micro-grid primarily operates while connected to the wider electricity network, but has the technical capability to disconnect and independently operate (this is also described as islanding). Micro-grids could also reconnect with the wider network.

Stand-alone power systems

For the purposes of this paper, we have defined stand-alone power systems as a more permanent form of a micro-grid. This is where an individual premise or a small community may desire to operate with no connection to the main network.

[20] Electricity Distribution Code, clause 4.1.2

[21] Micro-grid is considered a small private network, which normally operates connects to the main network, but with the technical ability to disconnect and operate stand-alone, with the ability to reconnect back to the main network.

[22] Stand-alone power system where a private network has permanently disconnected from the wider network with no ability to connect back.

[23] This allows the inclusion of proposals which may exceed property title boundaries, embedded networks or individual premises to be considered as differing hierarchy and scale of a micro-grid.

The Electricity Distribution Code was originally developed for an electricity network designed for customers staying connected to one main network with a central body such as the Australian Energy Market Operator managing frequency.

When a micro-grid or a stand-alone power system disconnects from the main network and operates outside the regulatory framework, although separated, many aspects of the code's technical regulations could still be effective as a guide. This is because many of the technicalities could apply even at smaller scales. The exception arises with frequency management where there are no requirements. Instead, when it comes to frequency management, the owner and or the operator of these smaller networks may likely have this responsibility. With limited information, it is presumed that commercial agreement may be in effect for the Victorian micro-grid trial projects.[24]

What should be appreciated is that frequency management is currently not part of the code and recent works by the Australian Energy Market Commission has identified system security matters such as frequency management could emerge as issues for micro-grids and stand-alone power systems.[25]

With growing community interest to explore these alternative models, the potential for these to become more common in Victoria is increasing. However, with limited available information, determining what may be an appropriate level of regulatory oversight requires further development – this could include technical standards for frequency management and other technical issues such as fault levels (discussed further in the micro-grid and fault level section on page 24).

We will closely follow these reviews and pilot projects to consider how and if our regulatory framework would interact with these models. Stakeholders are invited to provide feedback on what the code should consider as appropriate technical standards for emerging technologies such as micro-grids and stand-alone power systems.

Minimum technical requirements for embedded generators

The code contains a section focused on standards and obligations relating to embedded generators connected to the distribution network (section 7 of the code). Specifically, the code recognises an embedded generator as any generation technology that only connects to the distribution network and not the transmission system.

However, it is important to note that this section of code was established during a time when most installations of embedded generators were for commercial and industrial customers – these were

[24] See: Department of Environment, Land, Water and Planning, https://www.energy.vic.gov.au/microgrids

[25] Review of the regulatory framework for stand-alone power system , AEMC, https://www.aemc.gov.au/market-reviews-advice/review-regulatory-frameworks-stand-alone-power-systems

often synchronous technologies such as gas turbines or diesel generators. As a result, the embedded generator section of the code focused on these types and scales of technologies.

Synchronous generator represents a type of generator with certain technical characteristics when interacting with the distribution network. For example a diesel generator is a type of synchronous generator where the diesel engine rotates the generator, which results in electricity generation.

Non-synchronous generator represents new energy technology such as inverters used in solar and battery generators. Their technical attributes differ because solar panels and batteries are solid state with no moving parts and the electricity generated is based on Direct Current (DC) principals. The inverter converts the DC back into the useful Alternating Current (AC) format use in the typical household power point socket. Due to the DC to AC conversion, they are sometimes described as non-synchronous.

The code sets out minimum requirements for embedded generators regardless of technology type. These include conditions relating to negative sequence, harmonics, inductive interference, safe shutdown, restart following loss of supply, response to disturbance and frequency responsiveness.

As the uptake of newer technologies such as solar and battery systems grows, different considerations may be required for the code. We also expect that synchronous generators are likely to remain on the network in the foreseeable future, and the continued need to retain the existing conditions in the code. We welcome stakeholder views on the minimum technical requirements for embedded generators in the code

Specific requirements for synchronous generators

Section 7.4.1 of the code sets out conditions that are specific to synchronous generators, which have excitation (voltage control) or governor systems (to control speed therefore control frequency). However, the inverters used in solar or battery systems do not have these specific types of systems, and use different methods to manage their voltage and frequency to interact with the network. We invite stakeholder views on potential needs for minimum requirements for inverter based technologies not currently addressed by the code.

Aggregation and other models

New models of embedded generation such as aggregation are emerging in Victoria, as we recognised in our inquiry into the value of distributed generation.[26] These emerging models aim to combine many small individual solar generators or batteries under a single point of control, which can be used to imitate the abilities of a larger generator to provide frequency control and demand management for the network. However, we note that the requirements currently in the code are focused on larger scale installations and less so on these types of new models. We invite stakeholder feedback on what requirements, if any, should be considered to account for these new models such as aggregation.

Considering that the supply mix is changing and some of the conditions associated with synchronous generators may become less influential or be superseded by new models, it might be prudent to review these obligations to make sure they are still fit for purpose in a technology neutral way. We invite stakeholders to comment on what matters we should consider around these topics as the supply mix undergoes changes.

Fault levels

Fault levels are the limit of abnormal fault current an embedded generator may inject into the network. This issue is primarily associated with synchronous generators. New energy technologies such as solar inverters are considered to produce relatively less fault current.[27]

When a power system fault occurs, the fault current from the main network and local generators, in particular synchronous generators, combine together to deliver high fault current. Most standard protection equipment relies on this high fault current in its operation. However, excessive fault current could also damage equipment, therefore the code defines an upper limit of the fault level allowed in the system irrespective of their source. Equipment can then be designed to withstand up to the fault level defined in the code. We invite stakeholder views on whether any aspect of this matter should be considered.

Micro-grids and fault level

For any equipment and systems connected to the main network, managing the fault level to be within code limits would be a design requirement when installing these systems. This condition

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[26] True value of distributed generation , Essential Services Commission , https://www.esc.vic.gov.au/sites/default/files/documents/distributed-generation-inquiry-stage-2-final-report-network-value.pdf

[27] Fact sheet, AEMO, https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Reports/2016/AEMO-Fact-Sheet-System-Strength-Final-20.pdf

would also apply to micro-grids connected to the main network. However, if a micro-grid disconnects to operate in island mode (independent operation from the main network), the fault level could reduce for the micro-grid. If the micro-grid only used inverter based generators (which are considered relatively to produce less fault current), the combination of reduced fault level from being disconnected and lower fault current from inverters could limit the effectiveness of the standard protection equipment inside the micro-grid.

We could consider introducing conditions where such scenarios must be considered (for example install different type of protection equipment) or alternatively require a minimum fault level to ensure the protection equipment works. We invite stakeholder views on this matter. Further information can found in appendix G.

Register of embedded generation

From December 2019, new rules[28] require a national register of embedded generators to be established. Our code has had a similar register requirement for some time, but with the introduction of a national register, there may be opportunities to harmonise these requirements together, and we invite stakeholder views and feedback.

Other technical regulations

Our code launch forum of December 2018 was attended by a diverse mix of stakeholders including Government department, other regulators, distributors, retailers, industry bodies, new energy businesses and other interested parties. One theme raised by stakeholders was to consider harmonising the code with the latest technical standards and or other jurisdictional approaches, where appropriate.

The code includes a number of other technical regulations related to the management of the distribution system, but references older technical standards or different approaches. These older technical standards may have since been updated and we recognise that other jurisdictions have adopted different practices and approaches. For completeness, the following section addresses these relevant technical standards currently set out in the code.

[28] Register of distributed energy resources, AEMC, https://www.aemc.gov.au/rule-changes/register-of-distributed-energy-resources

Harmonics

Harmonics is a measure of poor power quality (and describes the distortion in the pure sine wave of the power system ideal for all equipment). High levels of harmonics can lead to wastage of electricity. Both distributors and customers have responsibility to manage harmonics. For example, distributors must manage the network voltage harmonic limits and customers should be installing equipment that does not distort the harmonics outside the limits.

The code currently uses a combination of Victorian specific parameters and an old American based technical standard. This is different to the National Electricity Rules, which has adopted the Australian Standard.[29]

The main difference observed between the two approaches is that the Australian Standard primarily focusses on distributors managing their network wide voltage harmonics limits. Our code expands slightly from this, placing separate requirements for distributors and customers, that is:

- distributors are to manage voltage harmonics limits as defined by the code, which is slightly lower compared to the Australian Standard; and
- customers are to manage current harmonics limits.

We invite stakeholder views whether we should retain the current code standards or harmonise with the National Electricity Rules by adopting the Australian Standard for harmonics. Further information can be found in Appendix E.

Negative sequence

Negative sequence voltage is part of an analytical method used in power engineering. It describes the voltage being in reverse rotation from the power system's normal rotation. During normal system operation, the presence of negative sequence could be a sign of some system imbalance due to a range of factors.

One way to picture negative sequence is the unbalanced wobble of a spinning fan blade, if the weight or shape of one of the blade is different to the other blades.

The distribution system is primarily designed as a three-phase system,[30] but most customers are supplied from a single phase – this means that customers do not generally experience negative

[29] National Electricity Rules, S5.1a.6 - AS61000.3.6: Electromagnetic Compatibility (EMC) – Limits – Assessment of emission Limits for Distorting loads in MV and HV power system

[30] A three phase system is where there are three separate power circuits, which have been electrical connected to form the three phase system. Each circuit or single phase provides power to the customers connected to that circuit.

sequence voltage. However, commercial and industrial customers generally receive power from the network as a three-phase supply.

We recognise that the National Electricity Rules[31] allow for slightly higher negative sequence limits than our code. Although stakeholders have not recently raised any issues with these standards, we welcome stakeholder feedback as part of this issues paper. Further information can be found in Appendix F.

Power factor

> **Power factor** is a measure of the efficient use of electricity. The closer a customer's power factor is to 1, the more efficient their usage may be. For example a small welding machine may have relatively poor power factor compared to a washing machine or a dish washer. Unless measures are taken to improve power factor, higher electricity consumption or wastage may result.

To minimise electricity wastage and losses on the network, the ideal case would be the power factor being close to 1. However, this is not always practical and customers have different capabilities (such as being able to afford modern high performance appliances) to influence their power factor. Therefore the power factor is set as a range to be managed within as set under clause 4.3 of our code.

If power factor becomes too low across the network, there will be increased power wastage on the network and all customers will share the cost of this wastage. Based on our initial review, the power factor range set out in our code is slightly more flexible than those allowed under other jurisdictions. Although stakeholders have not recently raised any issues with these standards, we welcome stakeholder feedback as part of this issues paper. Further information can be found in Appendix D.

Load balance

> **Load balance** refers to those customers having a three phase power supply that their equipment and systems should be balanced across these three phases.

The electricity network is an interconnected system between distributors and customers. When customers who use three-phase power operate with balanced equipment, this assists with the overall system balance management. When this is not the case, a customer on a three-phase

[31] National Electricity Rules, Table S5.1a.1

power supply may contribute the system to being less balanced, which could potentially affect other three-phase customers.

Because negative sequence may be a sign of system imbalance, if one customer's load imbalance is determined to be the cause of excessive negative sequence, distributors may seek that customer to remediate the issue. The code currently sets the imbalance limits customers should operate within. Although stakeholders have not recently raised any issues with these limits, we welcome stakeholder feedback as part of this issues paper.

Disturbing load

> **Disturbing loads** come from equipment or plant which, by their operation, may affect supply quality at the connection point. Such equipment must be designed, installed and operated to manage this.

Distributors must manage the integration of particular types of assets, which may interfere with the normal operation of the system. For example, a train system drawing power as they move down the line or very large industrial motors starting up for manufacturing, could affect power quality.

Therefore, the design, installation and operation of such equipment and asset require coordination between customers and distributors to be managed within the code limits so as not to affect other customers. Although stakeholders have not recently raised any issues with these limits, we welcome stakeholder feedback as part of this issues paper.

Distribution system planning and other reporting

Following the summer outage of 2017-18, the Victorian government conducted a review after the event and highlighted the need to improve the transparency and accessibility of information on network constraints, outage events and trends over time.[32] The review recommended that distributors make this information available on its websites.

Currently in the code, distributors are required to publish an annual public report that must identify network constraints and opportunities for demand management and embedded generation.[33] This information has also been visualised through an online map based system.[34]

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[32] Post event review – Power outages 28 and 29 January 2018, Department of Environment, Land, Water and Planning, https://www.energy.vic.gov.au/safety-and-emergencies/past-energy-emergencies

[33] Electricity Distribution Code, clause 3.5

[34] Australian Renewable Energy Mapping Infrastructure, ARENA, https://nationalmap.gov.au/renewables/

We recognise that this information may offer potential commercial opportunities to businesses when distributors are considering alternatives to network solutions (under the National Electricity Rules there are also separate requirements as part of the demand management incentive scheme and demand management innovation allowance mechanism).[35]

We are also aware of distributors producing interactive online maps that report on the outages occurring on their networks.

We welcome stakeholder views on possible improvements on transparency and the accessibility of network information for customers or relevant businesses.

Switching and power line carriers

The code retains some old technical standards. One relates to overvoltage protection against atmospheric origin or due to switching.[36] The other is distributors being able to use the power line itself to transmit communication signals.[37] Although stakeholders have not recently raised any issues with these matters, we welcome stakeholder feedback as part of this issues paper.

[35] National Electricity Rules, Schedule 5.8, clauses 6.6.3 and 6.6.3A

[36] Clause 4.2.3

[37] Clause 4.2.5

3. Other code issues

Since the last major review of the code, there have been a number of legislative changes that are not reflected in the code. This includes some definitional changes and redundant legislation still being mentioned.

We will take this opportunity to clarify and update the code. If you would like to make a submission to us on the issues raised in this chapter, we recommend you consider the questions posed throughout this chapter.

Questions to be considered for this chapter

If you would like to make a submission to us on issues raised in this chapter, we recommend you consider the following questions as part of your response.

Updates to definitions in the code

22. Are there any defined terms that you think are no longer correct or relevant that we need to address?
23. Should we align as much as possible and adopt national definitions set out in Appendix I? What may be the potential benefits or issues to align with the national definitions?

Further clarifications

24. Are there particular clauses that stakeholders think need to be made clearer?

Updates to definitions in the code

In making energy codes, we take into account relevant national frameworks and legislation. As part of this review, we will examine and consider whether we should replace a number of existing definitions in the code with definitions from the NER and the Electricity Act. Consistency in definitions mitigates the risk of confusion around interpretation and application for distributors who need to be compliant with the national framework and our jurisdictional framework. This in turn, should reduce compliance costs. In addition to the definitions in the NER, we will also consider definition changes adopted for the latest STPIS and Distribution Reliability Measurement Guideline review.

Clarification of reliability standards

The code includes a provision for the setting of reliability standards in Victoria (clause 5.2). These reliability standards can help drive appropriate investment in the network to balance the costs and benefits of providing reliable electricity to customers. The approach to setting these reliability standards vary across state jurisdictions.[38]

In Victoria, reliability standards have not been directly examined since the commission's 2006-10 price determination review (when the regulation of distribution pricing was our responsibility at the time). Currently, some distributors have applied the performance targets set by the Australian Energy Regulator as a proxy for reliability standards in Victoria.[39] It should be noted that the reliability performance targets that Australian Energy Regulator have set are part of the service target performance incentive scheme (STPIS) which is a form of economic regulation.[40]

However, the purpose of reliability standards in the code is to indicate an expected level of service on the network. In other words, the reliability standards are the minimum level of reliability a customer can expect.

We welcome stakeholder feedback on the setting of reliability standards in Victoria.

Updates to align with legislative changes

Since the code was originally written, there are clauses that reference regulation and legislation, which may be out of date and no longer applicable. Through this review we will take the opportunity to update these references and remove them if they no longer apply. Of those changes, we seek to retain the original intent of the clauses as well as referencing the relevant instruments.

For example, clause 4.2.1 references 'Electricity Safety (Network Asset) Regulations 1999'. The current relevant regulations are dated 2009. Therefore we may consider rewording this to be 'current version from time to time of the Electricity Safety (Installation) Regulations'.

Clarifying the language of certain code provisions

As a part of this review, we will also take the opportunity to clarify the language of certain provisions in the code. The amendments will be made if it improves readability and consistency throughout the code.

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[38] State of the energy market 2018, page 146, AER

[39] See: https://www.powercor.com.au/what-we-do/the-network/powercor-network-performance/ Viewed: 10 July 2019
https://www.powercor.com.au/what-we-do/the-network/citipower-network-performance/ Viewed 10 July 2019
https://www.ausnetservices.com.au/Residential/Electricity/Reliability viewed 10 July 2019

[40] National Electricity Rules, Clause 6.3.2, (a), (3)

Appendix A – Our role and purpose of the code

Our role

The commission is Victoria's independent economic regulator. Our key objective is to promote the long-term interest of Victorian consumers with respect to the price, quality and reliability of essential services.[41]

Among other things, we are responsible for granting licences to anyone wishing to generate, transmit, distribute or retail electricity in Victoria. We may grant licences subject to any conditions we consider appropriate having regard to our objectives under the:

- Electricity Industry Act (2000) and the
- Essential Services Commission Act (2001).[42]

Licenced electricity distributors are required to comply with energy rules that we set out for them. These rules are set out in codes and guidelines and include (but are not limited to):

- Electricity Distribution Code
- Guideline 14: Electricity Industry – Provision of services by electricity distributors
- Guideline 15: Electricity Industry – Connection of Embedded Generation

In addition to state laws and our regulations, distributors are governed under the national regulatory framework. This framework is established under the National Electricity Legislation and the National Energy Rules. It generally differs from our remit by focusing on the economic regulation of the businesses and not on the non-economic regulation bits (for example service standards and technical standards).

Purpose of the code

The purpose of the code is to set minimum service standards for the distribution network that tries to safeguard system security and provide a level of service protections for customers.

> The purpose of this Code is to regulate the following activities so that they are undertaken in a safe, efficient and reliable manner:
>
> (a) the distribution of electricity by a distributor for supply to its customers;

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[41] Essential Services Commission Act (2001), section 8, (1), (2)

[42] Electricity Industry Act (2000), sections 19–20

(b) the connection of a customer's electrical installation to the distribution system;

(c) the connection of embedded generating units to the distribution system; and

(d) the transfer of electricity between distribution systems.

The code has been in effect for many years setting out the service and technical standards distributors must deliver to customers. It was first written when the electricity distribution network was designed and operated under different circumstances. For example, the network was planned and designed for a system where a small number of large generators in specific locations supplied almost all of the electricity demand in Victoria. The network was then primarily focused on transmitting and distributing that power across the state.

The code provided technical parameters that the distributors had to meet. These were set to ensure network security, a reliable supply at a cost effective level and set the minimum level of service the customers could expect to receive from the distributors.

Since then, the electricity industry is rapidly changing, which has affected the way the network is maintained and operated. One such change is the introduction and uptake of technology that allows customers to have more control of their own electricity, such as solar panels and batteries. This means that the code may need to be updated to reflect what the network will need to do to ensure the code still delivers network security, customer protections and the service customers want.

What the code is not meant to do

It is also important to note that the code is not meant to be used as a means to promote or incentivise any particular technology. However, it is important that the code takes innovation into consideration and does not set any unnecessary barriers that prevent innovation while ensuring the system remains secure and customers are still afforded appropriate levels of protection.

Appendix B – Voltage level

Table 1

	Electricity Distribution Code		Australian Standards (AS 60038)	
	Voltage level (V)	Steady state operating range	Voltage level (V)	Steady state operating range
Low voltage	230	Table 1 (+10%, -6%)	230	Table 1 (+10%, -6%)
	400		400	
	460		460	
High voltage[43]	-	Table 1 (±6% urban) (±10% rural)	3,300	Table 3 (±10%)
	6,600		6,600	
	11,000		11,000	
	22,000		22,000	
	-		33,000	
	66,000	Table 1 (±10%)	66,000	Table 4 (no information)

The code and Australian Standard AS60038 nominal voltage comparison

[43] High voltage is defined as exceeding 1,000V - Australian Standard 3000, 1.4.128, (c)

Appendix C – Voltage range

Table 2

STANDARD NOMINAL VOLTAGE VARIATIONS				
Voltage Range for Time Periods				**Impulse Voltage (kV)**
Voltage level (kV)	**Steady State**	**Less than 1 minute**	**Less than 10 seconds**	
< 1	+10% -6%	+14% -10%	Phase to Earth +50% -100% Phase to Phase +20% -100%	6 kV
1 – 6.6	±6 % (±10 % Rural Areas)	±10%	Phase to Earth +80% -100% Phase to Phase +20% -100%	60 kV
11				95 kV
22				150 kV
66	±10%	±15%	Phase to Earth +50% -100% Phase to Phase +20% -100%	325 kV

Table 2 is the complete voltage range extracted from our code (clause 4.2.2) as reference. It has been observed that many jurisdictions have adapted the Australian Standard (AS61000.3.100) for the low voltage range (below 1000V AC). It is less clear whether AS61000.3.100 has been adapted for voltage range above 1000V AC.

Appendix D – Power factor

Victorian Electricity Distribution Code

Table 3

POWER FACTOR LIMITS						
Supply Voltage in kV	Power Factor Range for Customer Maximum Demand and Voltage					
	Up to 100 kVA		Between 100 kVA - 2 MVA		Over 2 MVA	
	Minimum Lagging	Minimum Leading	Minimum Lagging	Minimum Leading	Minimum Lagging	Minimum Leading
< 6.6	0.75	0.8	0.8	0.8	0.85	0.85
6.6 11 22	0.8	0.8	0.85	0.85	0.9	0.9
66	0.85	0.85	0.9	0.9	0.95	0.98

Table 3 is the extract of the power factor range from our code. A customer must use best endeavours to keep their electrical installation power factor within the table 3 range under clause 4.3 of the code.

National Electricity Rules

Table 4

Power factor range	
Supply voltage	**Power factor range**
>400kV	0.98 lagging to unity
250kV - 400kV	0.96 lagging to unity
50kV – 250kV	0.96 lagging to unity
1kV – 50kV	0.9 lagging to 0.9 leading

Table 4 is information from the National Electricity Rule (v123) power factor requirements.

New South Wales

The NSW Services and Installation Rules state a customer to maintain the power factor not less than 0.9 lagging up to 50kV connection services.

South Australia

Table 5

POWER FACTOR LIMITS						
Supply Voltage in kV	Maximum Demand of electrical demand					
	Up to 100 kVA		Between 100 kVA - 2 MVA		Over 2 MVA	
	Minimum Lagging	Minimum Leading	Minimum Lagging	Minimum Leading	Minimum Lagging	Minimum Leading
< 6.6	0.8	0.8	0.85	0.8	0.9	0.85
6.6 to 66	0.8	0.8	0.85	0.85	0.9	0.9

Table 5 is the power factor information available from the South Australia Power Networks Services and Installation Rules.

Queensland

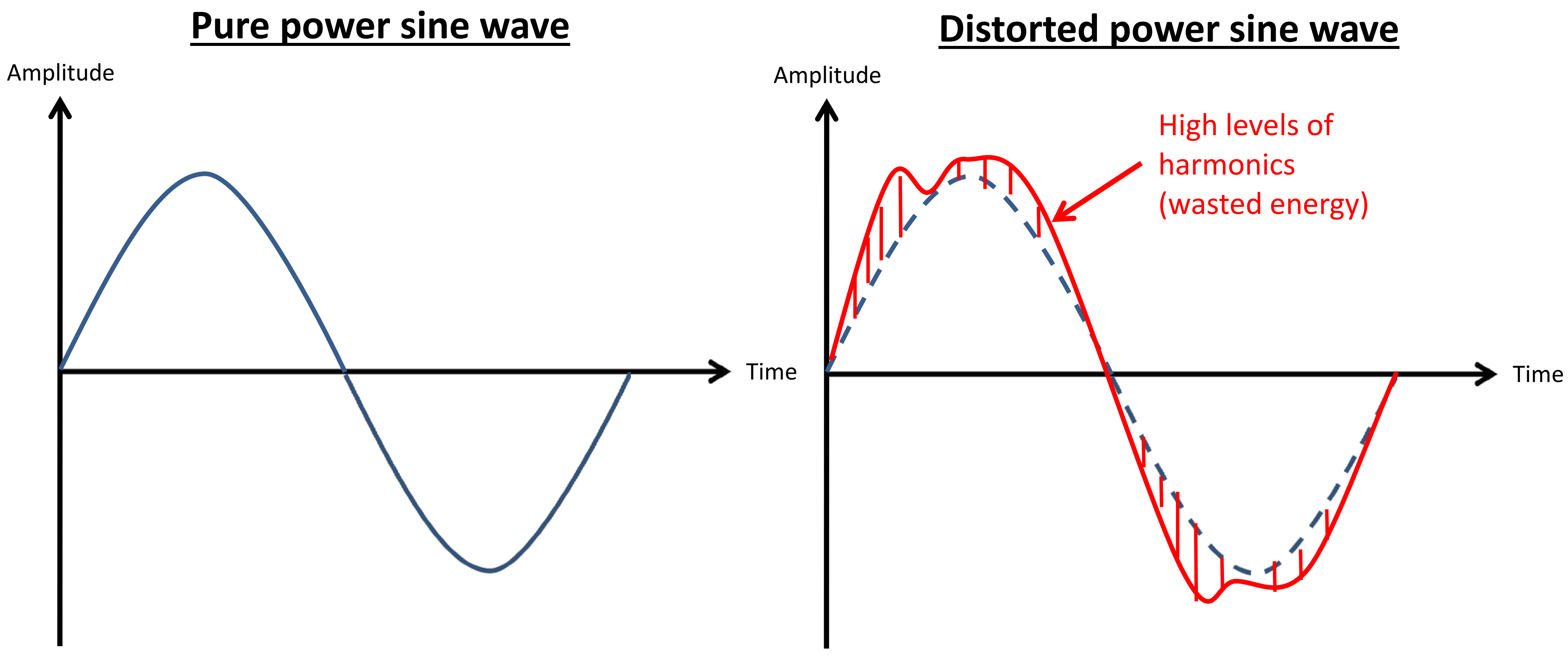
Table 6

Power factor performance	
Supply voltage	**Power factor range**
50kV – 250kV	0.95 to unity
1kV – 50kV	0.9 lagging to 0.9 leading
Less than 1kV	Above 0.8 lagging but not leading

Table 6 is the power factor information available from the Energex Services and Installation Rules

Appendix E – Harmonics

Figure A – Harmonic concept



Not to scale

Victorian Electricity Distribution Code

Table 7

VOLTAGE HARMONIC DISTORTION LIMITS			
Voltage at point of common coupling	**Total harmonic distortion**	**Individual voltage harmonics**	
		Odd	**Even**
< 1 kV	5%	4%	2%
> 1 kV and ≤ 66 kV	3%	2%	1%

Table 7 is the voltage harmonic limits Victorian distributors are required to manage under clause 4.4.1 of the code.

Table 8

CURRENT HARMONIC DISTORTION LIMITS						
	Maximum Harmonic Current Distortion in Per-cent of I_L					
	Individual Harmonic Order "h" (Odd Harmonics)					**Total Harmonic Distortion**
I_{SC}/I_L	**<11**	**11 ≤ h <17**	**17 ≤ h < 23**	**23≤ h < 35**	**35 ≤ h**	
<20*	4.0%	2.0%	1.5%	0.6%	0.3%	5.0%
20<50	7.0%	3.5%	2.5%	1.0%	0.5%	8.0%
50<100	10.0%	4.5%	4.0%	1.5%	0.7%	12.0%
100<1000	12.0%	5.5%	5.0%	2.0%	1.0%	15.0%
>1000	15.0%	7.0%	6.0%	2.5%	1.4%	20.0%

Table 8 is the current harmonic limits customers are required to manage under clause 4.4.3 of the code.

National Electricity Rules

Table 9

VOLTAGE HARMONIC DISTORTION LIMITS			
Voltage at point of common coupling	**Total harmonic distortion**	**Individual voltage harmonics**	
		Odd	**Even**
< 1kV	8%[44]	5% to 6%	2%
> 1kV and ≤ 35kV	6.5%[45]	5% to 6%	2%
> 35kV and ≤ 230kV	3%[45A]	2% to 5%	1.5%

Table 9 is the summary of table 1 and 2 from AS61000.3.6:2001 under the National Electricity Rules, S5.1a.6.

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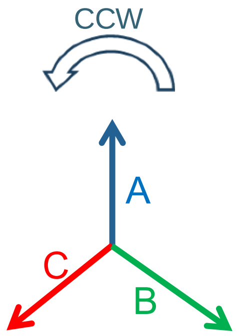
[44] AS61000.3.6, Compatibility level

[45 & 45A] ibid, Planning level

Appendix F – Negative sequence

Figure B – Negative sequence concept

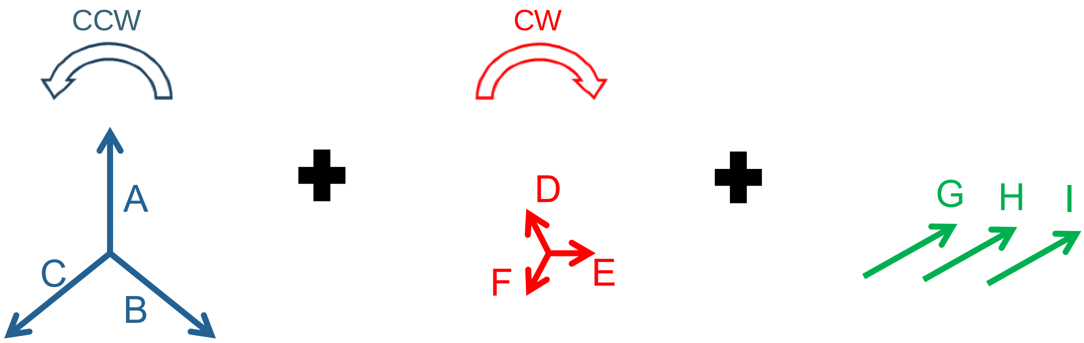
Balanced



Positive sequence

Under ideal normal operation, the three phase power system voltage would be balanced and rotating normally with no other components being present. In the engineering analytical method, this normal rotation is called the positive sequence (rotating counter clock wise in this case).

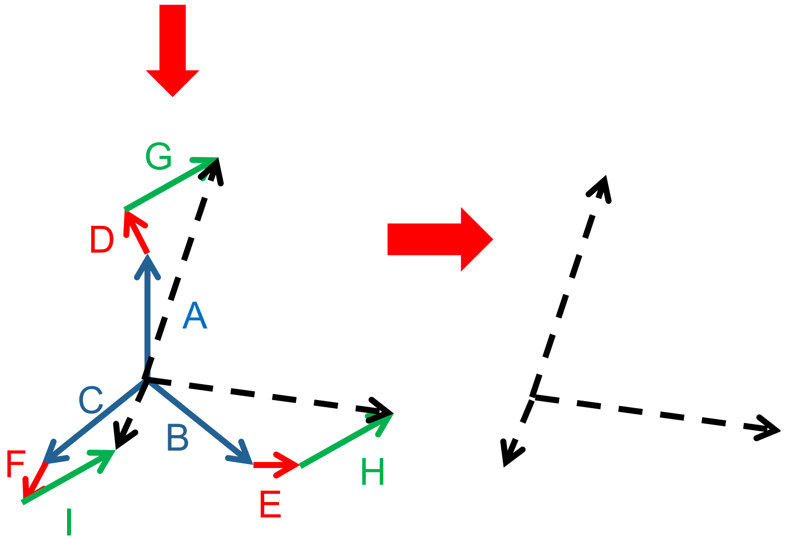
Unbalanced



Positive sequence

Negative sequence

Zero sequence



How the components add together

The resultant unbalanced voltage

Due to a range of factors, the power system could experience a level of imbalance even during normal operation. When this occurs other components such as negative sequence can be detected in addition to positive sequence. The above diagram illustrates these components individually.

The left illustrates what the total summated unbalanced system may look like when added together (by connecting the same coloured arrows back to back). The dashed black represents the resultant unbalanced system.

Note: Accentuated diagram to illustrate concept

Electricity Distribution Code

Table 10

Negative sequence		
Voltage	**Duration**	**Maximum negative sequence (% of nominal voltage)**
All voltage levels	Steady state	1%
	5 minute every 30 minute	2%

Table 10 is a summary of the code clause 4.6.

National Electricity Rules

Table 11

Negative sequence			
Voltage	**Duration**	**Maximum negative sequence (% of nominal voltage)**	**Note**
10kV to 100kV	30 minute average	1.3%	Non-contingent Credible contingent and protected
	10 minute average	2%	General
	1 minute average	2.5%	Once per hour
Up 10kV	30 minute average	2%	Non-contingent Credible contingent and protected
	10 minute average	2.5%	General
	1 minute average	3%	Once per hour

Table 11 is a summary of the National Electricity Rules table S5.1a.1.

Appendix G – Fault level

Electricity Distribution Code

Table 12

DISTRIBUTION SYSTEM FAULT LEVELS		
Voltage Level kV	**System Fault Level MVA**	**Short Circuit Level kA**
66	2500	21.9
22	500	13.1[46]
11	350	18.4
6.6	250	21.9
<1	36	50.0

Table 12 is the extract of the maximum fault level limits required by embedded generators not to exceed under clause 7.8 of the code.

[46] The jurisdictional derogation of the National Electricity Rules provisions the declared shared network with different fault level for certain parts of the Victorian 22kV network.

Appendix H – Guaranteed Service Level exclusions

Currently we have six types of scenarios that distributors can apply to us to exclude from our guaranteed service level scheme. The table and explanation below examines our exclusions from the Australian Energy Regulator's exclusions in the Distribution Reliability Measures Guideline.

Exclusion Criterion	Victorian Scheme	National Scheme
Load Shedding	- Load shedding due to a shortfall in generation, but excluding a shortfall in embedded generation that has been contracted to provide network support, except where prior approval has been obtained from the Commission	- Load shedding due to a generation shortfall
Other load shedding	- Automatic load shedding due to the operation of under frequency protection following the occurrence of a power system under-frequency condition - Load shedding at the direction of AEMO or a system operator	- Automatic load shedding due to the operation of under-frequency relays following the occurrence of a power system under-frequency condition - Load shedding at the direction of AEMO or a System Operator
Shared transmission network	- Supply interruptions caused by a failure of the shared transmission network	- Load interruptions caused by a failure of the shared transmission network.
Transmission connection assets	- Supply interruptions caused by a failure of transmission connection assets, except where the interruptions were due to inadequate planning of transmission connections and the distributor is responsible for transmission connection planning	- Load interruptions caused by a failure of transmission connection assets except where the interruptions were due to (a) actions, or inactions, of the Distribution Network Service Provider that are inconsistent with good industry practice; or (b) inadequate planning of transmission network connections points and the Distribution Network Service Provider is responsible for the planning of transmission network connection points

Exercise of legislative obligation, right or discretion		- Load interruptions caused by the exercise of any obligation, right or discretion imposed upon or provided for under jurisdictional electricity legislation or national electricity legislation applying to a Distribution Network Service Provider
Emergency Services		- Load interruptions caused or extended by a direction from state or federal emergency services, provided that a fault in, or the operation of, the network did not cause, in whole or part, the event giving rise to the direction.
Major Event Day	- Supply interruptions on a day where the unplanned interruption frequency exceeds particular thresholds	- Interruptions may also be excluded that occur on days where the daily unplanned SAIDI for the DNSP's distribution network exceeds the major event day boundary, when the event has not been excluded under the seven exclusion clauses described above.
Demand Response	- Where prior approval has been obtained from the Commission, load shedding due to a shortfall in demand response initiatives	

Load Shedding

Interruptions due to shortfall in registered generation are excluded under both the Victorian and national guaranteed service level schemes. There is a difference in what type of generation is included in the exclusion. Under the Victoria scheme, a shortfall in embedded generation specifically contracted to provide network support are not excluded unless prior approval has been obtained from the commission.

In 2005, the commission concluded that network support is the responsibility of distributors and that they are responsible for delivering energy and ensuring reliability whether it is through network augmentation or through entering into network support agreements with embedded generators.[47] Customers' reliability should not be negatively affected by how the distributor chooses to meet peak demand. Failure or lack of embedded generators should not be an excuse for poor service delivery. By exempting these interruptions, reliability could worsen without either the distributors or the generators being held responsible. Distributors should be held accountable for their procurement and management of contracted embedded generators. The Australian Energy Regulator on the other hand has not made this distinction.

Other Load Shedding

Both the Victorian guaranteed service level scheme and the national scheme exclude:

- Automatic load shedding due to the operation of under frequency relays following the occurrence of a power system under-frequency condition
- Load shedding at the direction of the market or system operator

Shared Transmission Network

Both the Victorian guaranteed service level scheme and the national scheme exclude interruptions caused by a failure of the shared transmission network.

Transmission Connection Assets

Both the Victorian guaranteed service level scheme and the national scheme exclude interruptions caused by a failure of shared transmission connection assets except where the interruptions are due to inadequate planning by the distributor. However, the national scheme goes one step further. It does not exclude interruptions caused by a failure of shared assets where the distributor's actions or inactions are inconsistent with good industry practice.

A distributors' control over such supply interruptions extends beyond just the planning function. For example, if a distributor failed to follow the standard network operation, management and or procedures, which resulted in a connection asset failure, it is in the distributors' control to avoid and therefore difficult to justify the interruptions exclusion.

Exercise of legislative obligation, right or discretion

The national guaranteed service level scheme excludes interruptions that are caused by obligations that are set under the jurisdictional electricity legislation or national electricity legislation. The Victorian guaranteed service level scheme does not include this exclusion.

In 2015, we examined whether to include this clause, but decided not to as there were particular obligations put on distributors that could cause an interruption, but it was something that was within their control to mitigate against. For example, the Electricity Safety Management Scheme may

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[47] Essential Services Commission, *Electricity Distribution Price Review, Final Decision Volume 1: Statement of Purpose and Reasons*, October 2005, page 123

enable interruptions to happen, but they are generally within the distributors control to minimise the interruption. Therefore, distributors have influence on which interruptions are or are not excluded

Emergency Services

The national guaranteed service level scheme excludes interruptions resulting from a direction from state or federal emergency services, provided that the fault in the network did not cause the emergency event. This is currently not excluded in the Victorian guaranteed service level scheme.

We note that a distributor may be directed to interrupt supply to a group of consumers or may be denied access to undertake repairs as a result of state of federal emergency service's needs. For example, in the event of a fire, an emergency services officer may issue an order for a distributor to shut down the electricity in a certain area before they can operate safely.

Major Event Day

A prominent difference between the exclusion criteria in the Victorian guaranteed service level scheme and the national guaranteed service level scheme is how Major Event Days (MEDs) are defined as an exclusion. Our thresholds were last reviewed in 2011.

While MEDs are excluded in both schemes, the definitions are different under the Victorian and national schemes. Under the Victorian scheme, the threshold is set as a SAIFI measure,[48] while the national threshold sets a SAIDI measure.[49] Victoria is currently the only jurisdiction in Australia defining Major Event Days by frequency thresholds

A 2005 review by the Commission concluded that an exclusion criterion based on the frequency of interruptions was a better indicator that a large number of events had occurred which would stretch the distributors' resources to restore supply than an exclusion criterion based on the duration of interruptions. Basing on duration of interruptions could wrongly exclude events where there was a poor response by electricity distributors and not a MED.[50]

In setting the threshold to define MEDs, the Commission aimed to only exclude around one event per five years, whereas under the national thresholds, up to five days per year have been excluded. The Australian Energy Regulator's approach in defining MEDs can provide a useful basis for reliability performance comparisons across Australia and international electricity distributors. Furthermore it may be beneficial for a consistent definition of MEDs to be applied across the Victorian and national schemes.

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[48] Our thresholds were last reviewed in 2011. We are currently the only jurisdiction that sets MEDs this way.

[49] The AER adopted the IEEE standard 1366-2012, Under this method, a Major Event Day is defined as a day where the natural log daily SAIDI exceeds 2.5 standard deviations from the mean (this is done under the natural log due to the skewness of reliability performance data).

[50] Essential Services Commission*, Electricity Distribution Price Review, Final Decision Volume 1: Statement of Purpose and Reasons*, October 2005, page 123

We note that if the definition of Major Event Days for the Victorian guaranteed service level scheme is changed to align with the national definition, the thresholds (levels) for the guaranteed service level payments may need to be changed.

Demand Response

Under the Victorian guaranteed service level Scheme we may consider excluding interruptions due to shortfalls occurring as a result of demand response innovation. The Australian Energy Regulator does not currently allow this as an exclusion.

Demand management could play a role in the operation of the electricity system by reducing or shifting electricity usage away from peak periods in response to financial or other forms of incentives.

Demand response initiatives can offer benefits by enabling augmentation of the network to be deferred or avoided. However, the use of demand response initiatives is not widespread as the market for it is not yet mature. This becomes relevant because if the market is not mature enough to deliver the expected reduced demand, this may lead to an interruption that could entitle customers to a guaranteed service level payment.

With prior approval from the Commission, interruptions that may happen if demand responses do not work are excluded. When seeking approval, distributors are required to demonstrate that the customers who are impacted by failures in demand response have been identified and the potential benefits of the demand response initiatives are bigger than the disruption caused by the interruption.

Appendix I definitions

term	ESC definition	AER definition
Inadequate level of customer service Or Worst serviced customer	no definition in code, but the guiding principal has been the one per cent of customers experiencing the worst supply performance per annum	means a customer experiencing greater than four times the network average for unplanned SAIDI on a three-year rolling average basis compared with a network average customer.
Momentary interruption	an interruption continuing for a period of less than one minute, except where an interruption of less than one minute has already occurred within that one minute period	an interruption to a distribution customer's electricity supply with a duration of three minutes or less, provided that the end of each Momentary Interruption is taken to be when electricity supply is restored for any duration.
Sustained interruption	an interruption of duration longer than one minute	
Urban feeder	a feeder, which is not a CBD feeder, with load density greater than 0.3 MVA/km	is a feeder which is not a CBD feeder and has a three year average maximum demand over the three year average feeder route length greater than 0.3 MVA/km