Jemena Electricity Networks (Vic) Ltd

2026-31 - Electricity Distribution Price Review - Revised Regulatory Proposal

Supporting justification document

Voltage and Power Quality Management - Business Case

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Appendix A Sensitivity Analysis - Compliance Outcomes
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Abbreviations

Abbreviation	Description
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AMI	Advanced Metering Infrastructure
CER	Consumer Energy Resources
DNSP	Distribution Network Service Provider
DSA	Distribution System Augmentation
DVM	Dynamic Voltage Management
EDCoP	(Victorian) Electricity Distribution Code of Practice
ESC	Essential Services Commission
HV	High Voltage
JEN	Jemena Electricity Networks (Vic) Ltd
kV	Kilo Volt
LDC	Line Drop Compensation
LV	Low Voltage
MVAr	Mega Volt Ampere Reactive
MW	Mega Watt
NPV	Net Present Value
OLTC	On-Load Tap-Changer
OPEX	Operations and Maintenance Expenditure
PQ	Power Quality
PV	Photovoltaic
TS	Terminal Station
VVC	Volt - VAr Control
ZSS	Zone Substation

1. Addressing the Draft Determination

As part of our initial regulatory proposal, Jemena Electricity Network (**JEN**) proposed a Voltage & Power Quality Management Program (**Program**). This Program originally aimed to facilitate additional solar exports while ensuring network voltage and power quality remain within a safe and compliant range.

The Program was aligned with the latest industry trends and was a critical requirement to meet our customers' expectations. The AER considered our case as a part of its review of our initial regulatory proposal and outlined several concerns in its draft decision.

AER Feedback

- A more limited version of this program could be prudent and efficient. However, is not prudent in its current form, as the net present value (**NPV**) incorrectly quantifies the benefits.
- Jemena does not appear to be at risk of non-compliance in the absence of this program.
- Jemena should consider a more targeted project to maintain voltage compliance, limited to dynamic voltage control capabilities, rather than the full suite of reactor and capacitor bank expenditure.
- Step change operating expenditure should be accounted for in the normal base/trend.

We have undertaken further analysis and present additional information for the AER to consider in this revised proposal to demonstrate the viability of this Program.

Updates to Address Feedback

- JEN has limited the scope of this project – focusing exclusively on our obligations to maintain network voltage as per Section 20.4 of the Electricity Distribution Code of Practice (version 2)
- JEN has included additional information around a recent non-compliance event.
- JEN has provided additional information on the need for additional reactors and capacity bank control.
- JEN has absorbed the proposed network operating expenditure.

2. Background

2.1 Historic Approach to Voltage Regulation is not fit for the Energy Transition

JEN has relied on our fleet of zone substation on-load tap changer (**OLTC**) transformers and capacitor banks to locally regulate voltage and reactive power compensation at the high-voltage (**HV**) level for each zone substation. Addressing voltage issues at the low-voltage (**LV**) level (the physical point at which the majority of customers are connected to the electricity distribution network) has been managed by manually adjusting distribution transformer taps on-site and adjusting HV voltages for calculated voltage drops.[1]

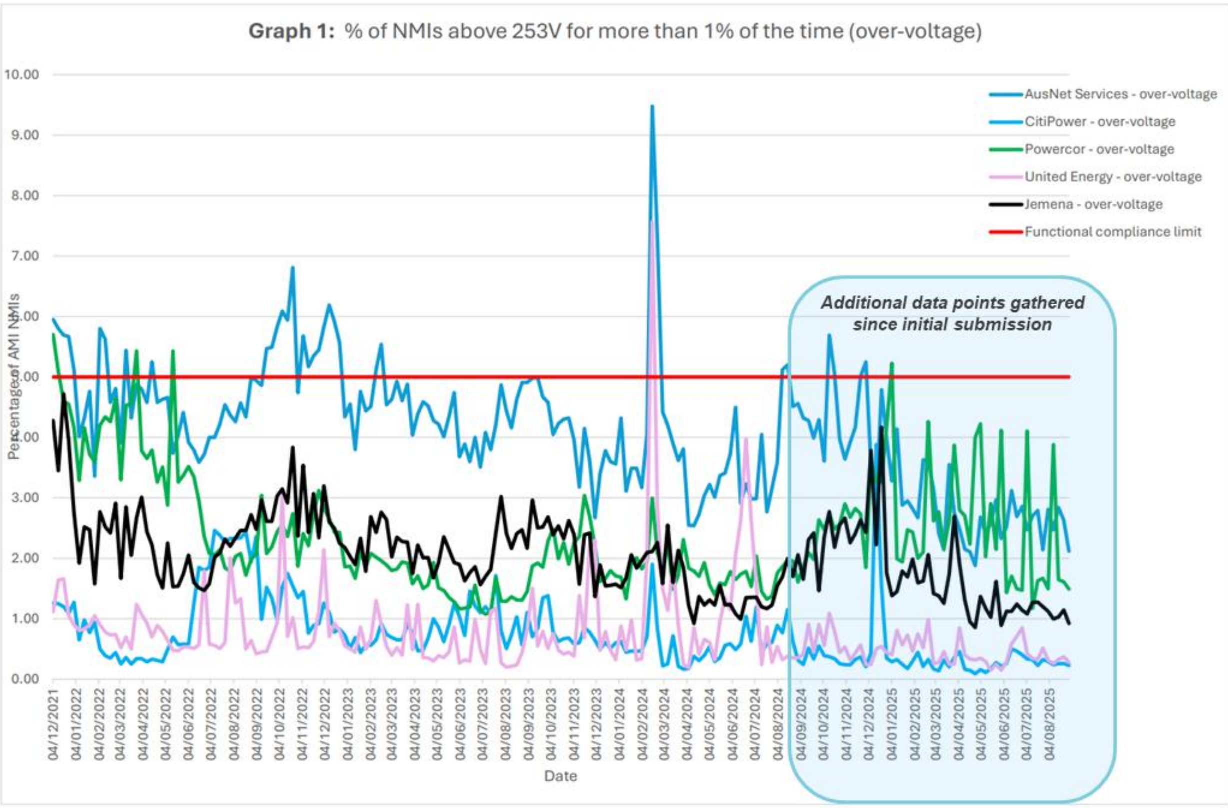
Historically, this method of voltage regulation was adequate, however, as noted in our initial regulatory proposal,[2] the growth of customer energy resources (**CER**), the electrification of appliances that were previously supplied by the reticulated gas network and transportation electrification means investment is required to maintain voltage compliance and avoid adverse customer outcomes.

2.2 JEN's Compliance Obligations

Section 20.4 of The Electricity Distribution Code of Practice (**EDCoP**) outlines the acceptable voltage range, which JEN must maintain across our network. Because of the above-noted trends, it is increasingly difficult to maintain the voltage within this range. This is evidenced by the sharp degradation in JEN's voltage performance in the period between preparing our initial regulatory proposal and this revised proposal.

Figure 2-1 shows improvements in JEN's over-voltage compliance from 2022 to mid-2024, however, recently there has been a sharp degradation in performance, with the over-voltage rising to over 4% in December 2024.

Figure 2-1: Victorian Over-Voltage Performance December 2021 - August 2025

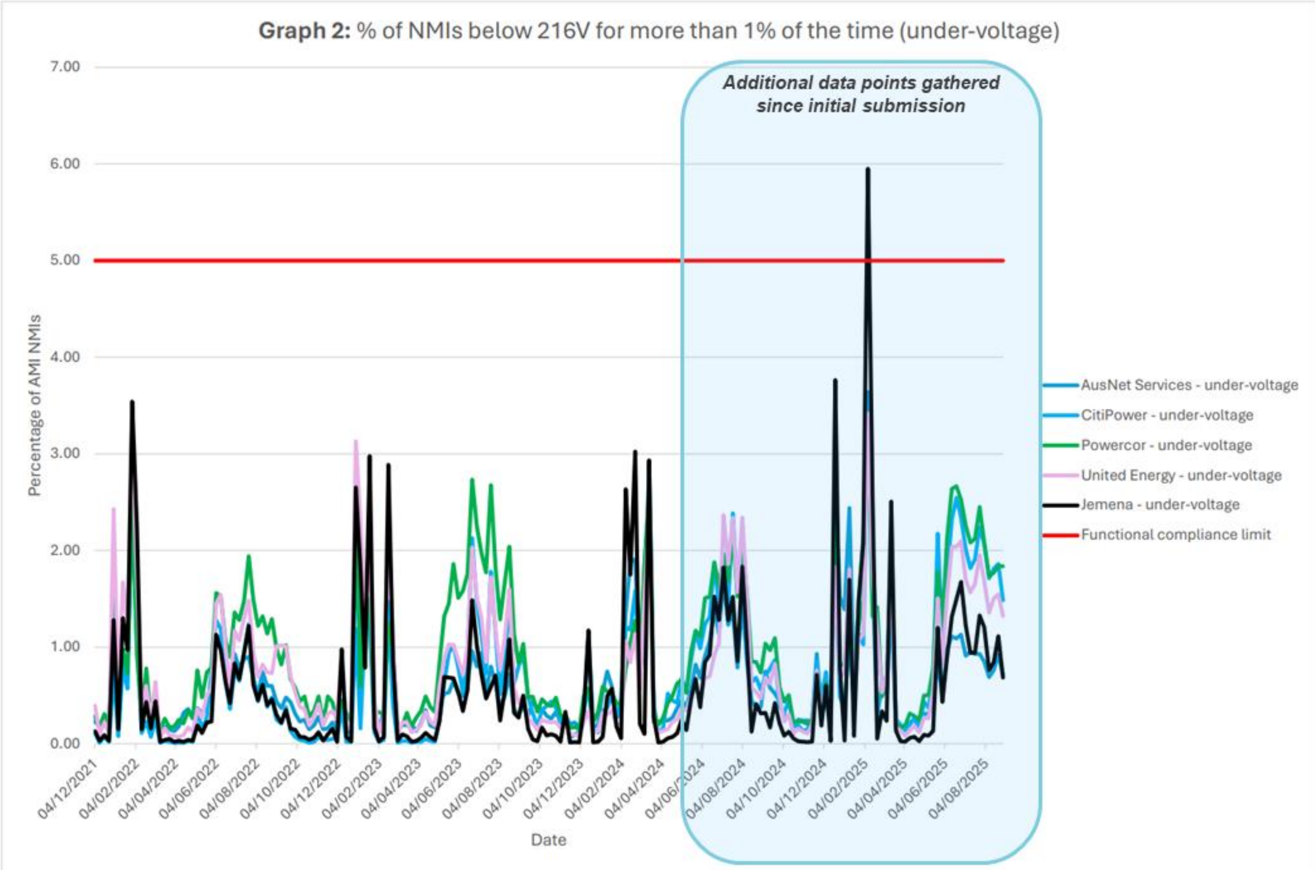


Source: [Voltage performance data | Essential Services Commission]

1 These voltage – drop assumptions are based on the expected maximum demand and the impedance of the network between the voltage regulator and the customer.

2 *JEN – RIN – Support – Voltage and PQ Management Program – 20250131*

Figure 2-2: Victorian Under-Voltages December 2021 - August 2025



Source: *Voltage performance data | Essential Services Commission*

This recent degradation in JEN's ability to maintain appropriate voltage levels is even more pronounced when considering under-voltages. Historically warm weather has increased the percentage of JEN customer's experiencing voltages outside the approved range, as shown in Figure 2-2. Until 2025 JEN has been able to contain these under-voltage 'spikes' within ECDoP requirements. However, February 2025 heatwave led to 5.95% of JEN's customers experiencing under-voltages exceeding the limits set out in the EDCoP.

2.2.1 2025 Under-Voltage Event & Rectification Commitments

After submitting JEN's initial proposal, a significant heatwave from the 2nd to the 4th of February 2025 resulted in JEN failing to maintain threshold limits set out in the EDCoP's minimum voltage requirements. An Increase in underlying maximum demand, primarily driven by significant air-conditioning load at the localised LV level, led to:

- A total of 22,411 customers (or 5.95% of customers) experiencing steady-state voltages below 216V for more than 1% of the calendar week. These customers were dispersed across 1,115 different distribution substations and 29 different zone-substations supply areas, and

- 10,604 customers (or 2.8% of customers) experiencing extreme under-voltage below 207V. Their locations were spread across JEN's network - including 673 different distribution substations and 28 different zone substation supply areas.

While preparing our January to March 2025 voltage performance report, JEN became aware of this incident and began engaging with the Essential Services Commission (**ESC**). Following an investigation into the root cause of the event, JEN presented a plan to the ESC to rectify the issue. This will involve a program targeted at 'worst-served' under-voltage areas, including installing and upgrading transformers and LV circuits.

These works will continue into the 2026-31 regulatory control period (**next regulatory period**). They will be complemented with both the investments outlined in Section 5 below and JEN's Distribution Substation Augmentation (**DSA**) Strategy.[3] These works will bring JEN's steady-state under-voltage in line with our EDCoP requirements and ensure compliance is maintained until the end of the period.

Given the increasing pace of both CER adoption and electrification as forecast in AEMO's *Step Change* Scenario,[4] we expect the challenges of maintaining appropriate voltage levels to be further exacerbated over the next regulatory period.

2.3 Customer Impacts

In some instances, extreme voltages can cause lights to flicker or machines to lag, making their effects visible to customers. However, customers may not always be aware of the damage this is doing to their appliances – or even that they are experiencing non-compliant voltages.

In addition to reducing appliance lifespan, both over and under voltages can cause them to draw more electricity than would be necessary under normal voltage, increasing the customer's energy costs. This issue has the potential to compound as electricity becomes a greater proportion of the customer's energy mix, reducing the lifespan of more of their appliances and adding cost to a greater proportion of their energy bills. Additionally, when the distribution network experiences over-voltages, rooftop solar may be constrained or turned off as a means of bringing voltages back into normal range. This could push the electricity generation mix flowing through the network to more emissions-intensive fuel sources.

Figure 2-3 summarises the types of typical customer and compliance impacts as a result of under-voltage and over-voltage events.

[3] JEN – RIN Support - Distribution Substation Augmentation Strategy – 20250131 – Public. Note, JEN's DSA Strategy does not deal with under-voltages directly. It is intended to accommodate additional load growth, which will in turn prevent further voltage degradation

[4] AEMO | 2025 Inputs Assumptions and Scenarios Consultation

Figure 2-3: Under-Voltage & Over-Voltage Events

Under-Voltage Event ('brownout')	Over-Voltage Event
	
Caused by: Higher demand than the transformer can supply	**Caused by:** More electricity flowing through the network than there is demand for
Customer impact: • Appliances draw more energy than typically required to compensate for the lower voltage. This increases the customer's electricity consumption. • This increased energy consumption can also cause appliances to overheat or wear out the appliance sooner than expected. • Lights may flicker and motors (like those in fridges and air conditioning systems) may stall.	**Customer impact:** • Solar exports are constrained – or turned off completely. • Appliances are 'force fed' more electricity than required. This increases the customer's electricity consumption. • This increasing electricity consumption can also cause appliances to overheat the appliance sooner than expected.
Non – Compliance 5% of the network experiencing voltages under 216V	**Non – Compliance** 5% of the network experiencing voltages over 253V

3. Identified Need

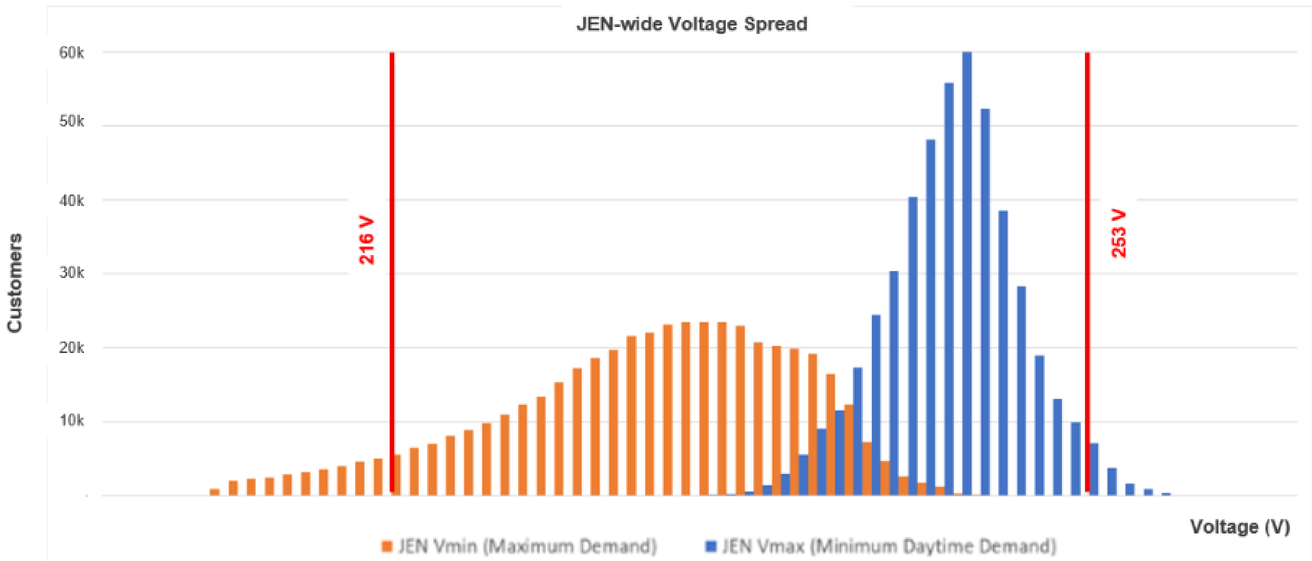
3.1 Historic Voltage Performance

JEN began reporting steady-state voltage compliance levels to the ESC in late 2021. Over this reporting horizon, JEN's most significant under-voltage and over-voltage events both occurred within the last 12 months. Table 3-1 and Figure 3-1 show the voltage spread and the percentage of customers who experienced voltages below 216V and above 253V during these events.

Table 3-1: JEN LV Voltage Distribution (FY2024 – 2025)

Date	Demand Condition	1st Percentile	50th Percentile	99th Percentile	Voltage Spread[5]	% Under[6]	% Over[7]
2nd February 2025	Maximum	208 V	231 V	244 V	36 V	7.1%	0.0%
6th December 2024	Minimum	237 V	246 V	255 V	18 V	0.0%	3.8%

Figure 3-1: JEN LV Voltage Distribution at Minimum and Maximum Demand (FY242024 – 2025)



5 Difference between the 99th percentile and 1st percentile voltage.

6 Percentage of AMI meters below 216 V. This percentage includes all customers with voltage level below 216V, which is different to the EDCoP voltage performance metric.

7 Percentage of AMI meters above 253 V. This percentage includes all customers with voltage level above 253V, which is different to the EDCoP voltage performance metric.

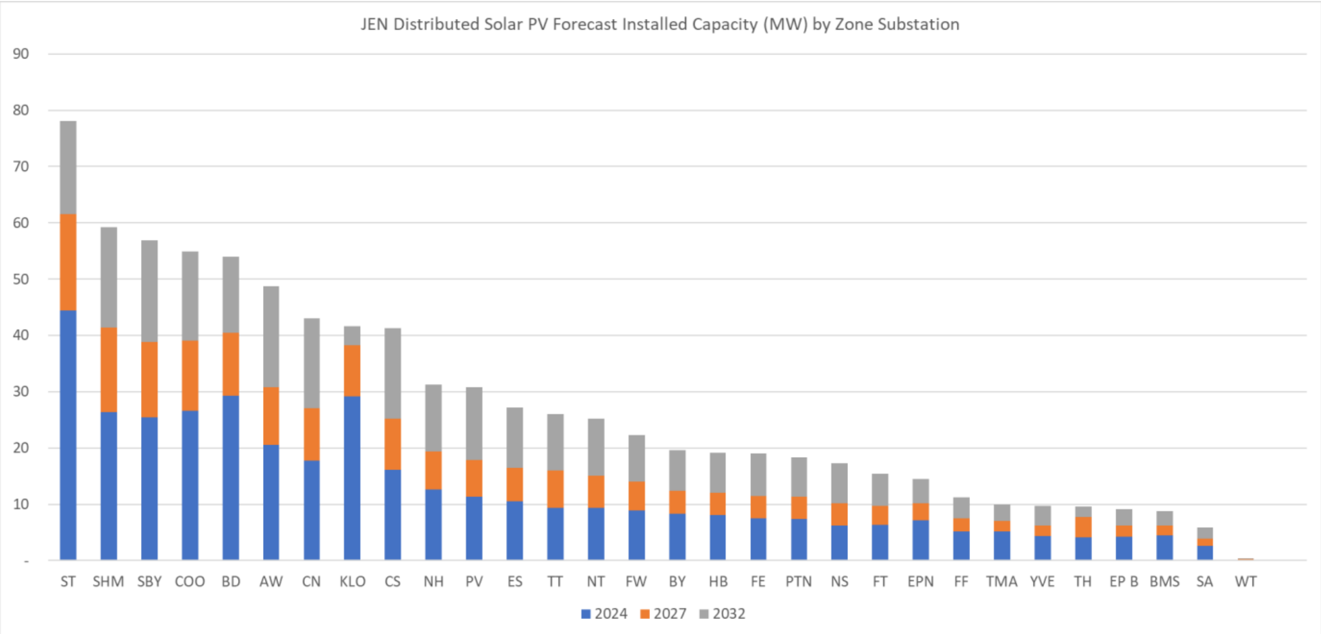
3.2 Forecasted Over-Voltage Performance[8]

3.2.1 Rooftop Solar Penetration

Rooftop solar exports at times of low demand increases the risk of non-compliant over-voltages. Between 2023 and 2024 the percentage of JEN's customers with installed rooftop solar has risen from 16% to 19%.[9] This increase is expected to continue through the next regulatory period. Figure 3-2 below shows JEN's actual and forecast solar penetration across the network's zone substations and the changes to that distribution over a five and ten-year forecast period. The majority of forecast rooftop solar growth is in the outer urban growth corridors and newer underground residential estates.

These clusters of rooftop solar penetration provides guidance on areas of the network likely to experience voltage degradation in the next regulatory period.

Figure 3-2 – JEN's Actual and Forecast Distributed Solar PV Installed Capacity (MW) - by Zone Substation



3.2.2 Growth in Underground HV Cables

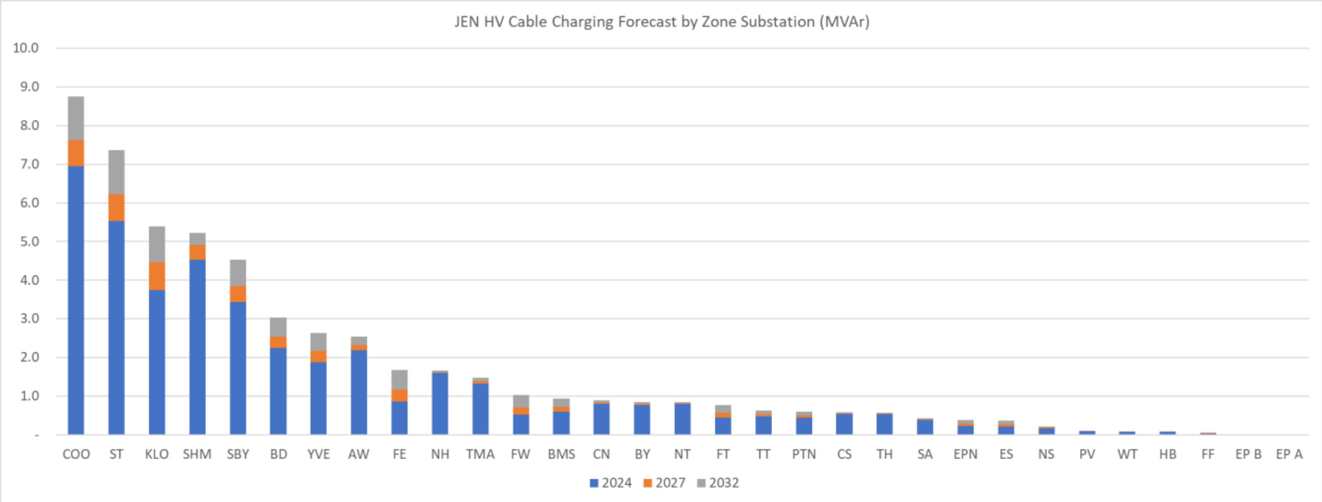
22KV underground cables also pose a risk to JEN's over-voltage compliance. These cables can omit a charging current that injects reactive power into the network, elevating network voltages. These effects are particularly noticeable at night when electricity demand is low and solar inverters are off-line and not supporting network voltage through their Volt-VAr settings.

Figure 3-3 below shows JEN's actual and forecast growth in underground cable charging reactive power by zone substation. The locations with the highest reactive power generation and the highest growth in cable charging are in the new 22 kV underground residential estates. As mentioned above, these locations will also have significant rooftop solar penetration. This will lead to a degradation in voltage performance during both the day and night in the coming regulatory period.

8 Note, as mentioned above, this paper only seeks solutions to addresses emerging issues with over-voltages and current under-voltage non-compliance, further degradations to under-voltage compliance have not been considered as they will be addressed by JEN's DSA Strategy.

9 This equates to an increase from 322MW to 372MW of capacity.

Figure 3-3 – JEN's Actual and Forecast HV underground cable charging (MVAr) - by Zone Substation



3.3 Identifying Sites for Intervention

Voltage variations are not uniform across JEN's network. To minimise the scope (and associated costs) of this remediation project, JEN has identified the worst-performing zone substations on our network. This was done by considering each zone-substation's current voltage performance and the projected impacts of the growth in rooftop solar and underground cables.

By limiting proactive interventions to just these worst-performing zone-substations JEN can maintain network-wide voltage compliance. This approach of limited and localised proactive investment is best complemented by additional reactive augmentation to address customer complaints as they arise.

4. Technical Considerations

When voltage issues arise on the distribution network, both innovative solutions (such as DVM) or the more traditional augmentation (such as installing tap position-controlled reactors/lowering the position of existing taps, etc.) can address these issues. JEN has designed a Program that is technically capable of maintaining our current compliance levels. The most efficient cost and technically feasible solution for a given voltage issue varies based on several factors.

4.1.1 Voltage spread

Large voltage spreads pose a challenge for many potential, lower-cost solutions for maintaining voltage compliance. For example, when DVM is used to 'boost' voltages at a zone substation, it affects all connected customers, non-discriminatorily. This means that customers who may have previously experienced voltage levels at the upper end of the compliant range are lifted into over-voltage.

Additionally, a large voltage spread also limits the effectiveness of manually adjusting tap settings to optimise the voltage range and load balancing between phases to improve voltage range, because it would affect all customers' voltages.

4.1.2 Transformer tap position

If tap positions at transformers are already set to their lowest during periods of minimum demand, there is no ability to adjust them even further. Where this occurs, we have considered several options to provide additional tapping range for voltage control at times of minimum demand, including:

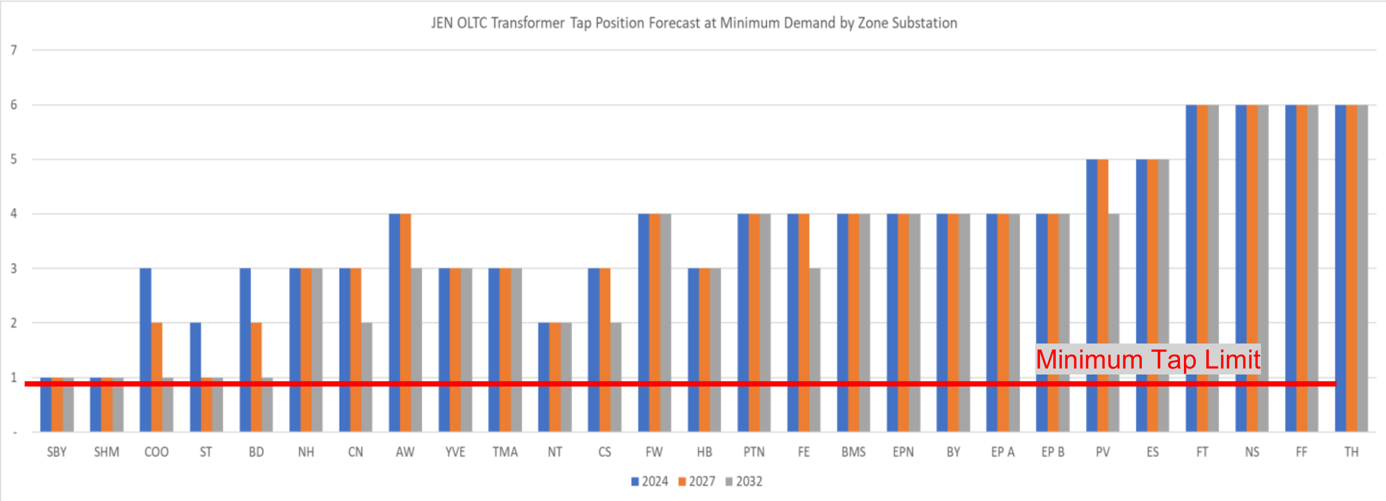
- Replacing transformers with new transformers, which have additional buck taps.
- Reducing setpoint voltages at terminal stations[10] and, if necessary, applying line drop compensation (**LDC**),[11]
- increasing the reactive power through the zone substation transformers to introduce a voltage drop across the transformers.

Figure 4-1 presents the actual transformer tap position (by zone substation) at JEN's historic and forecast minimum demand. As shown in the image, five of JEN's zone substations will be operating at their lowest transformer tap position by the end of the next regulatory control period. This means JEN will lose the ability to regulate the voltage effectively, and one of the solutions above needs to be deployed to readdress the voltage regulation.

[10] Most terminal station transformers are already operating at their extreme tap position; therefore, this option is no longer viable.

[11] LDC is a control system used to dynamically vary the voltage setpoints. Unlike DVM which uses all measured customer voltages to inform the setpoint, LDC uses the measured aggregated load – therefore setpoint used is based on an approximation of customer voltages.

Figure 4-1– JEN's Actual and Forecast Minimum Demand OLTC Transformer Tap Positions - by Zone Substation



Source: JEN internal forecast

5. Option Evaluation

5.1 Assessment Criteria

Based on the needs outlined above, JEN has developed a list of both credible and non-credible solutions. Solutions were deemed credible if;

- it is technically feasible;
- it is possible for JEN to deliver; and
- it would allow JEN to maintain its current level of over-voltage compliance[12] and ensure we can meet our under-voltage compliance obligations.

A comparison of the potential solutions, evaluated against these criteria is included in Table 5-1 below.

Table 5-1: Options Assessed

Option	Description	Cost	Feasible	Deliverable	Compliant	Credible
Option 1: 'Do Nothing'	Status quo expenditure maintained – no additional capital works are considered. JEN does not maintain an ad hoc reactive quality-of-supply program to resolve customer complaints.	$0M (FY26$)	✓	✓	x	x
Option 2: Targeted DVM, VAr Controllers and Reactors	A mix of proactive DVM & traditional augmentation targeted at the most at-risk substations, allowing JEN to maintain compliance at the lowest cost. JEN's reactive power quality program is significantly smaller than the current period	$28.72M (FY26$)	✓	✓	✓	✓
Option 3: Traditional Augmentation	Traditional augmentation targeted at the most at-risk substations, allowing JEN to maintain compliance. JEN's reactive power quality program is significantly smaller than the current period	$29.23M(FY26$)	✓	✓	✓	✓
Option 4: DVM only	As suggested by the AER's consultants, only DVM is implemented. However, this will not allow JEN to maintain over-voltage requirements JEN's reactive power quality program is significantly	$28.05M(FY26$)	✓	✓	x	x

12 Note, JEN has also considered the costs of targeting varying compliance levels (ranging from 2% - 5% non-compliance, the results of this analysis are presented in Appendix A)

Option	Description	Cost	Feasible	Deliverable	Compliant	Credible
	smaller than the current period.					
Option 5: Non-Network Solutions	This option would rely on using third-party demand response solutions to maintain appropriate voltages. This would require a significant increase in the penetration of orchestrated demand and CER, which is unlikely to eventuate or technically feasible and least cost in the next regulatory period.	Not Estimated	x	x	x	x

5.2 Costings

A comparison of the costs for each of the options listed above is included in Table 5-2 below.

Table 5-2: Costings per annum (FY26$)

Option	FY27	FY28	FY29	FY30	FY31	Total
Option 1: 'Do Nothing'	$0M	$0M	$0M	$0M	$0M	**$0M**
Option 2: Targeted DVM, VAr Controllers and Reactors	$4.5M	$5.5M	$5.5M	$5.8M	$7.4M	**$28.72M**
Option 3: Traditional Augmentation	$5.0M	$5.5M	$5.5M	$5.8M	$7.4M	**$29.23M**
Option 4: DVM only	$4.9M	$4.6M	$6.4M	$7.6M	$2M	**$25.7M**
Option 5: Non-Network Solutions	Not Estimated	Not Estimated	Not Estimated	Not Estimated	Not Estimated	**Not Estimated**

5.3 Option 1: Do Nothing

Credible Option	Cost (FY26$, direct)	Projected Under-Voltage Non-Compliance by 2031	Cost to Deliver Under-Voltage Compliance Levels (FY26$, direct)	Projected Over-Voltage Non-Compliance by 2031	Cost to Deliver Over-Voltage Compliance Levels (FY26$, direct)
x	$0M	>6%	$0M	8%	$0M

5.3.1 Description

This is not a credible option as it would not allow JEN to reach or maintain compliance. Voltages are expected to continue to deteriorate over the regulatory period, as no investments are made to offset increasing CER penetration and electrification. Further, JEN would not have sufficient allowance to conduct minor network augmentations in response to customer voltage complaints.

5.3.2 Customer & Compliance Outcomes

JEN would not operate within the EDCoP limits, with an estimated 8% of customers experiencing voltages above maximum compliant levels by 2031 and >6% of the network experiencing voltages below minimum complaint levels by 2031. In addition, JEN would not have sufficient regulatory allowance to conduct minor augmentation works to rectify voltage issues in response to customer complaints, this would result in a significant degradation in customer experience. This is not a credible option.

5.4 Option 2: Targeted DVM, VAr Controllers and Reactors

Credible Option	Total Cost (FY26$, direct)	Targeted Under-Voltage Non-Compliance by 2031	Cost to Deliver Under-Voltage Compliance Levels (FY26$, direct)	Targeted Over-Voltage Non-Compliance by 2031	Cost to Deliver Over-Voltage Compliance Levels (FY26$, direct)
✓	$28.72M	5%	$9.2M	4%	$19.5M

5.4.1 Description

This is the most cost-efficient credible option. It would utilise a mix of traditional augmentation and DVM capabilities to maintain JEN's current over-voltage performance and ensure JEN can achieve under-voltage compliance.

5.4.1.1 Under-Voltage Investments

Given that DVM is not an effective option to address JEN's under-voltage performance requirements (due to the voltage spread at times of maximum demand), traditional augmentation would be used to address this issue,

JEN has completed an assessment of each distribution substation's under-voltage and the relative contribution of each to JEN's network-wide voltage performance requirements. To achieve an under-voltage performance of 5% (functional compliance), JEN is required to undertake augmentation works at 35 distribution substations.

The total cost of this project is based on a unit rate of $271k per site ($June 2026, direct cost).[13]

5.4.1.2 Over-Voltage Investments

This solution involves (i) DVM, (ii) DVM-enabling augmentation, and (iii) tap changes & phase balancing to maintain 4% over-voltage performance. The sites identified for intervention have been selected based on a ranking of which zone substations are the highest contributors to deteriorating compliance. The most efficient cost and technically feasible solution for each zone substation has then been included in the overall program of work.

In addition, JEN proposes to retain a small reactive program of work to address customer complaints as they are expected arise from time to time.

Table 5-3: Option 2 Cost Breakdown

Voltage and PQ Management Program	Indicative Year	Cost ($M)[14]
DVM (VVC rollout) at 2 zone substations (ZSS) to address over-voltage		1.93
NS	2027	*0.58*
ST	2027	*1.35*
Tap position-controlled reactors at 5 ZSS to address over-voltage		13.46
SBY	*2028*	2.57
SHM	*2029*	2.87
COO	*2030*	2.94
ST	*2031*	2.39
BD	*2031*	2.68
Interlocked VAr controllers on 11 capacitor banks to address over-voltage		3.28
CN No.1 and No.2	*2027*	*0.60*
CN No.3, CS	*2028*	*0.90*
FF, NH	*2029*	*0.60*
ST, TH No.1	*2030*	*0.90*
TH No.2	*2031*	*0.30*
Tap changes & phase balancing to maintain voltage spread for DVM at 4 ZSS[15]		0.18
AW, NS	*2028*	*0.09*
CS	*2029*	*0.04*
HB	*2031*	*0.04*
Traditional investments to address under-voltage	2026-2031	9.2 (1.84 p.a.)
Power quality reactive program to address customer complaints	2026-2031	0.69 (0.13 p.a.)
Total Cost for 2026-2031 Regulatory Period	2026-2031	28.72

[13] This unit rate is developed based on prior experience of nine recently completed projects. We note this is higher than the unit rate of $205k used in our DSA Strategy; however, this additional cost is necessarily incurred due to the additional reconductoring work that will be required to address non-compliance.

[14] Direct unescalated costs, June 2026 dollars.

[15] These investments include distribution substation and low-voltage circuit remedial works to reduce the contribution they have to excessive voltage spread when aggregated at the zone substation DVM level. Sites with the largest contribution are targeted.

5.4.2 Customer & Compliance Outcomes

JEN would maintain current levels of over-voltage non-compliance and reduce under-voltage non-compliance to 5%. This ensures we would achieve EDCoP compliance, and customer complaints related to voltage would not increase.

5.5 Option 3: Traditional Augmentation

Credible Option	Total Cost (FY26$, direct)	Projected Under-Voltage Non-Compliance by 2031	Cost to Deliver Under-Voltage Non-Compliance (FY26$, direct)	Projected Over-Voltage Non-Compliance by 2031	Cost to Deliver Over-Voltage Non-Compliance (FY26$, direct)
✓	$29.23M	5%	$9.20M	4%	$20.03M

5.5.1 Description

This option also relies on traditional augmentation (no DVM) to maintain JEN's current over-voltage performance and ensure JEN can achieve under-voltage compliance.

5.5.1.1 Under-Voltage Investments

As DVM is not an effective solution to address under-voltage issues, this option would involve traditional augmentation discussed in Option 2 at the same worst preforming zone substations

5.5.1.2 Over-Voltage Investments

As discussed under Option 2, this option would involve procuring additional reactors and VAr controllers at various zone substations to address over-voltages. However, rather than utilising DVM at ST & NS we would rely exclusively on traditional augmentation.

Table 5-4: Option 3 Cost Breakdown

Voltage and PQ Management Program	Indicative Year	Cost ($M)[16]
Tap position-controlled reactors at 5 ZSS to address over-voltage		**13.46**
SBY	*2028*	2.57
SHM	*2029*	2.87
COO	*2030*	2.94
ST	*2031*	2.39
BD	*2031*	2.68
Interlocked VAr controllers on 11 capacitor banks to address over-voltage		**3.28**
CN No.1 and No.2	*2027*	*0.60*

16 Direct unescalated costs, June 2026 dollars.

CN No.3, CS	*2028*	*0.90*
FF, NH	*2029*	*0.60*
ST, TH No.1	*2030*	*0.90*
TH No.2	*2031*	*0.30*
Tap changes & phase balancing to the maintain voltage spread at 4 ZSS		**0.18**
AW, NS	*2028*	*0.09*
CS	*2029*	*0.04*
HB	*2031*	*0.04*
Traditional investments to address over-voltage at 2 ZSS		**2.43**
NS, ST	*2027*	2.43
Traditional investments to address under-voltage	**2026-2031**	**9.20** (1.84 p.a.)
Power quality reactive program to address customer complaints	**2026-2031**	**0.69** (0.13 p.a.)
Total Cost for 2026-2031 Regulatory Period	**2026-2031**	**29.23**

5.5.2 Customer & Compliance Outcomes

This option would deliver the same customer and compliance outcomes as Option 2, at a slightly higher cost. Therefore, although it is a credible option, it is not preferred.

5.6 Option 4: DVM Only

Credible Option	Total Cost (FY26$, direct)	Projected Under-Voltage Non-Compliance by 2031	Cost to Deliver Under-Voltage Non-Compliance (FY26$, direct)	Projected Over-Voltage Non-Compliance by 2031	Cost to Deliver Over-Voltage Non-Compliance (FY26$, direct)
x	$25.73M	5%	$8.77M	6%	$16.97M

5.6.1 Description

In response to our initial proposal, the AER's consultants (EMCa) suggested JEN utilise DVM exclusively to deliver voltage compliance. However, this is not a technically feasible solution.

5.6.1.1 Under-Voltage Investments

As discussed in Option 2 above.

5.6.1.2 Over-Voltage Investments

Unlike Option 2 & 3 this Option would focus on the worst preforming zone substations that also have available tapping range so DVM can be utilised.

Although the majority of the technology costs for implementing DVM have been incurred in the current regulatory period, additional capital expenditure is required to implement access points to process additional data from the 17 sites at which JEN would deploy DVM. Additionally, expenditure has also been included for minor augmentation works (tap changing and phase balancing) so DVM may be utilised to the extent possible without the associated reactor and capacitor controller functions.

As discussed above, the limited tapping range impedes the functionality of DVM, preventing JEN and our customers from realising the full benefit of the deployed investment.

Table 5-5: Option 4 Cost Breakdown

Initiative	Indicative Year	Cost ($M)[17]
DVM (VVC rollout) at 17 ZSS		**15.60**
NS, ST, SHM	2027	*3.02*
TT, BD, EPN	2028	*2.59*
ES, TH, FF, NH, TMA	2029	*4.32*
CN, BMS, PV, FT, COO, NT	2030	*5.69*
Tap changes & phase balancing maintain voltage spread for DVM at 15 ZSS		**0.69**
EPN	*2027*	*0.04*
AW, NS, FT, TMA	*2028*	*0.18*
TH, PTN, YVE, FF, BY	*2029*	*0.23*
ES	*2030*	*0.04*
HB, PV, BMS	*2031*	*0.13*
Traditional investments to address under-voltage	**2026-2031**	**8.77** (1.75 p.a.)
Power quality reactive program to address customer complaints	**2026-2031**	**0.69** (0.13 p.a.)
Total Cost for 2026-2031 Regulatory Period	**2026-2031**	**25.73**

5.6.2 Customer & Compliance Outcomes

Although compliance outcomes are better under this option than under Option 1, tap limitations prevent JEN from achieving the maximum benefit of the deployed DVM. Therefore, JEN would not be compliant with the EDCoP voltage requirements. Customers would experience poorer voltage performance.

5.7 Option 5: Non-Network Solutions

Total Cost (FY24$)	Projected Under-Voltage Non-Compliance by 2031	Projected Over-Voltage Non-Compliance	Credible Option
Not costed	Not estimated	Not estimated	x

[17] Direct unescalated costs, June 2026 dollars.

5.7.1 Description

This option would involve using third-party demand response solutions to resolve the voltage compliance for both under-voltages and over-voltages. As discussed above, JEN's voltage issues are concentrated in residential areas – this means traditional demand management (engaging with one large user and reaching an agreement where their demand can be curtailed) is not a viable option. Instead, JEN would be required to curtail the demand and rooftop solar exports of multiple residential customers. This is not a viable solution given the current low levels of orchestrated CER penetration.

5.7.2 Customer & Compliance Outcomes

JEN would not meet the voltage performance requirements outlined in the EDCoP. Additionally, JEN would not receive sufficient allowance to conduct minor augmentation works to rectify voltage issues in response to customer complaints, this would result in a significant degradation in customer outcomes. This is not a credible, nor economically efficient option.

6. Preferred Option

Option 2 is the preferred option as it is the most cost-efficient, technically feasible option, which will deliver functional compliance.

Appendix A
Sensitivity Analysis - Compliance Outcomes

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A1. Compliance Outcomes vs. Total Costs

JEN has undertaken a sensitivity analysis comparing the expenditure required to maintain varying levels of over-voltage non-compliance[18]. The results of this analysis are included in Table 6-1 below.

Table 6-1 – Sensitivity Analysis – Compliance Outcomes vs. Total Costs ($M FY26)

Over-Voltage Compliance Target	Option 2 – Targeted DVM, VAr Controllers and Reactors	Option 3 -Traditional Augmentations	Option 4 – DVM Only
Functional Compliance (5%)	$27.45	$28.00	Not possible (only 6% is achievable using DVM alone)
Maintain Performance (4%)	$28.72	$29.23	
Improved Performance (3%)	$32.20	$33.31	
Vic DNSP Peer Performance (2%)	$50.35	$55.89	

18 Note, for the purpose of this exercise under-voltage non-compliance is held constant at 5%.

Appendix B
Supporting Models

B1. Supporting Models

- *JEN – RP – Support – Voltage and Power Quality Management – CBAM – 20251201*
- *JEN - RP - Support - Voltage and Power Quality Management - EDCoP Performance and Cost - 20251201 - Confidential*