



Regulatory Investment Test for Distribution (RIT-D)

**Reliability Corrective Action
The Southwest QLD Network Area**

Options Screening Report

31/10/2025



Part of Energy Queensland

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

INTRODUCTION

Purpose

The National Electricity Rules (NER) require that, subject to certain exclusions, distribution network service providers who are looking to address an identified need, by investing in the network, must apply the regulatory investment test for distribution (RIT-D). This Options Screening Report (Report) has been prepared by Ergon Energy Corporation Limited (Ergon Energy) in accordance with the requirements of clause 5.17.4(e) of the NER and seeks information from all interested parties, as listed in clause 5.17.4(a) of the NER, about alternative potential credible options to address the identified need.

About Ergon Energy

Ergon Energy is part of Energy Queensland and manages an electricity distribution network which supplies electricity to more than 765,000 customers. Our vast operating area covers over one million square kilometres (around 97% of the state of Queensland) from the expanding coastal and rural population centres to the remote communities of outback Queensland and the Torres Strait.

Our electricity network consists of approximately 160,000 kilometres of powerlines and one million power poles, along with associated infrastructure such as major substations and power transformers.

We also own and operate 33 stand-alone power stations that provide supply to isolated communities across Queensland which are not connected to the main electricity grid.

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

CONTENTS

1.	Assumptions and Technical Characteristics of the Identified Need	4
1.1.	Location.....	4
1.2.	Existing supply arrangement.....	5
1.3.	Contribution to power system security or reliability.....	6
1.4.	Contribution to power system fault levels	7
1.5.	Operating profile.....	7
1.6.	Forecast	9
1.7.	Design Parameters and Specified Performance Levels for Reactive Power Compensation at Charleville	11
1.8.	Size of load reduction or additional supply	11
2.	Identified Need	11
3.	Potential Credible Options.....	13
3.1.	Credible Options Identified.....	13
3.1.1.	Option A: 10Mvar STATCOM	13
3.1.2.	Option B: Network Support Arrangement for the provision of reactive power via an external provider	15
4.	Social Licence and Community Engagement	16
4.1.	Social Licence	16
4.2.	Community Engagement	16
5.	Information to Assist Non-network Providers Wishing to Present Alternative Potential Credible Options	17
6.	Compliance Statement.....	17
7.	Appendix A – Design Parameters and Specified Performance Levels for Reactive Power Compensation at Charleville.....	20

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

1. ASSUMPTIONS AND TECHNICAL CHARACTERISTICS OF THE IDENTIFIED NEED

1.1. Location

Charleville is located in the Maranoa area of the Southwest Region of Ergon Energy's Network. The Charleville area is supplied via a single 272km 66kV sub-transmission feeder from T83 Roma 132/66/33kV bulk supply point (ROMA) and customers in Quilpie and Cunnamulla are supplied via separate 200km long 66kV feeders from Charleville. Distribution supply from Charleville 66/22/11kV zone substation (CHAR) and Cunnamulla 66/22/11kV zone substation (CUNN) is at 11kV for urban, and 22kV and 19.1kV single wire earth return (SWER) for more rural customers. Supply from Quilpie 66/11kV zone substation (QUIL) is predominantly 11kV, but also consists of extensive 19.1kV SWER networks. The distribution network supplied from these three zone substations supplies 5,379 customers and encompasses more than 10% of the total geographic area of Queensland.

Figure 1 provides an overview of the sub-transmission network in the region and the location of the zone substations supplied from ROMA. Figure 2 shows the site layout of CHAR.

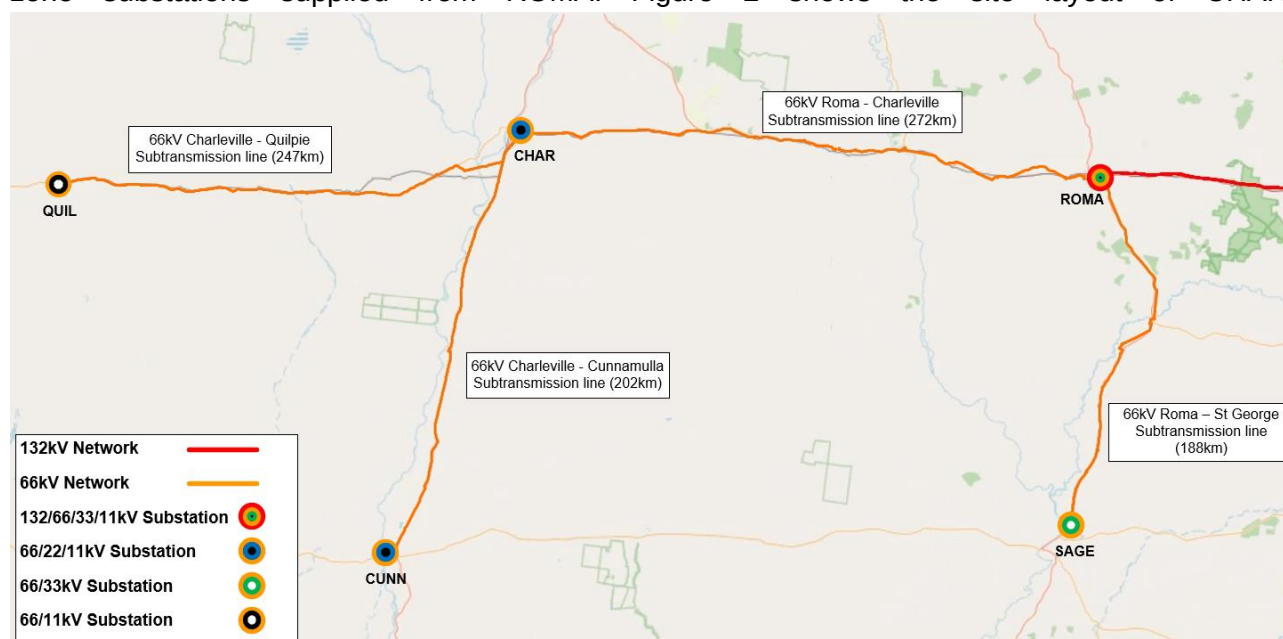


Figure 1 - Southwest 66kV sub-transmission network.

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report



Figure 2 – CHAR site layout.

1.2. Existing supply arrangement

Figure 3 provides a single line diagram showing the 66kV network supplying CHAR, CUNN and QUIL from ROMA bulk supply point. During normal operation, the 66kV network voltages are regulated by the ROMA T1 on load tap changer (OLTC) in combination with a variety of reactive plant installed at the downstream zone substations buses.

CHAR contains a 66/11kV transformer, a 66/22kV transformer, and a 22/11kV transformer linking the 22kV and 11kV busbars, providing backup for each of the 66kV transformers (as shown in Figure 3 below). CHAR contains a Static Var Compensator (SVC) connected to the 11kV bus. The SVC controls the 66kV bus voltage and has a range of 7MVar inductive to 10MVar capacitive.

The CHAR SVC is the only dynamic reactive plant in this part of the network and provides continuously variable reactive power compensation, set to control the CHAR 66kV bus voltage. The other reactive plant consist of fixed capacitor banks and reactors installed at CHAR and CUNN as shown in Figure 3. These fixed devices are manually controlled and can be remotely switched via their respective circuit breakers (CBs) (apart from CHAR 66kV R2 which lacks a CB) by system operators in order to manage reactive power flows within the system.

During times when the CHAR SVC is out of service, the fixed reactors and capacitor banks at CHAR and CUNN are manually switched to manage reactive power flows and bus voltages depending on

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

network loading. However, this switching creates transients on the network, is difficult to manage, and relies on some plant which is also approaching end of life. There is also insufficient reactive power capability to maintain voltages at all times and customer load shedding would be required during high load periods (estimated to be 24% of the time).

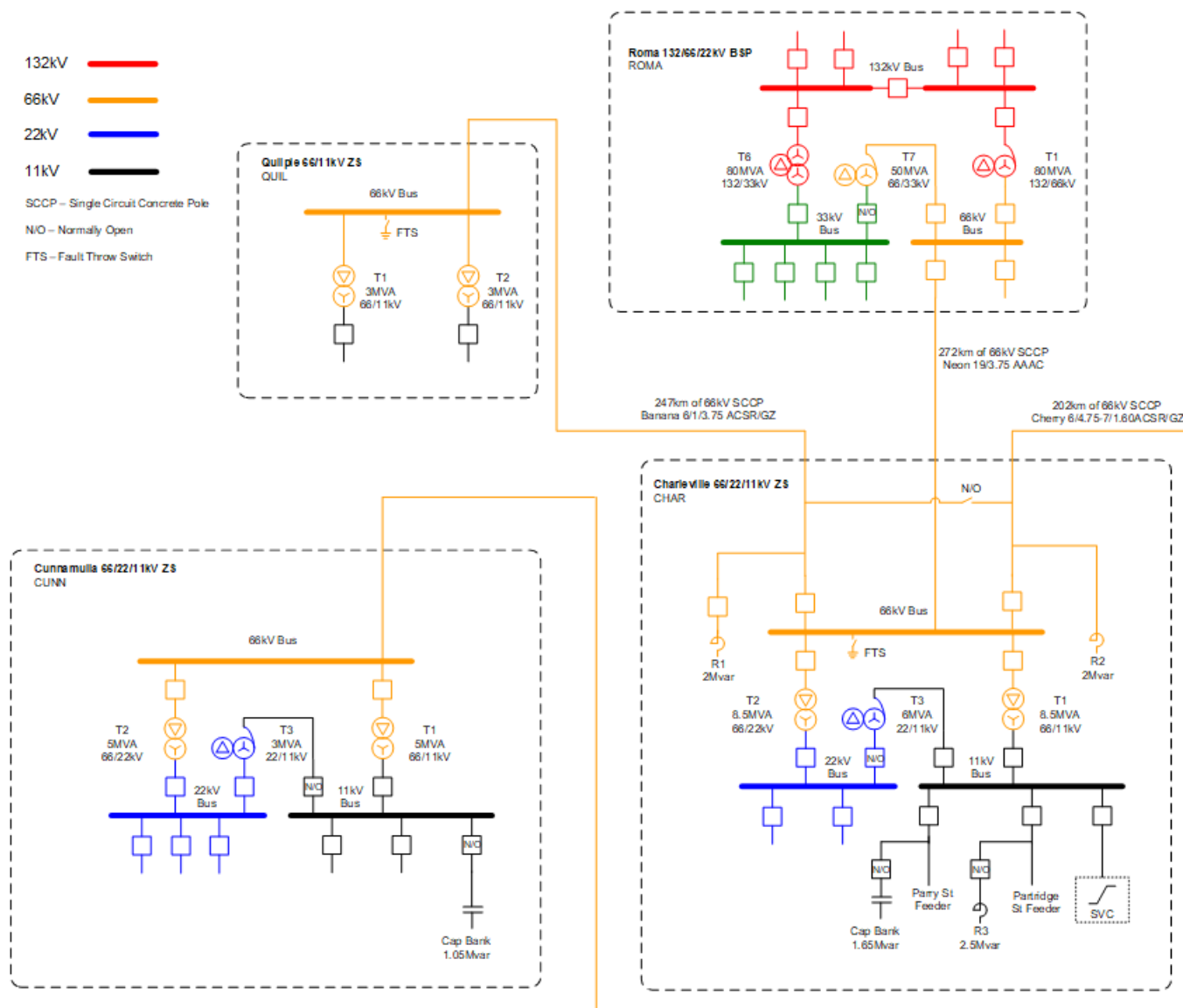


Figure 3 – Network single line diagram.

1.3. Contribution to power system security or reliability

The SVC plays a critical role in maintaining voltage stability and reliability of customer supply across Ergon Energy's Southwest network which includes Charleville, Quilpie, and Cunnamulla. This network is characterised by low fault levels making it susceptible to large voltage disturbances during switching of reactive plant and during load rejection events. By dynamically injecting or absorbing reactive power in response to system conditions, the SVC helps stabilise voltage fluctuations caused by load changes, faults, or switching operations. This improves the system's ability to withstand

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

disturbances and prevents voltage collapse, which is critical for maintaining continuous and reliable power supply.

The SVC also operates to balance the three-phase system via Negative Phase Sequence (NPS) correction, improving voltage balance and power quality for rural customers. This capability is required to correct the significant phase unbalance caused by the extensive SWER networks in the region.

1.4. Contribution to power system fault levels

Like other SVCs in general, the Charleville SVC is a shunt-connected device that provides reactive power support without contributing real power, therefore its direct contribution to fault current is minimal. However, by improving voltage stability and supporting system voltage during disturbances, the SVC can help maintain the operational integrity of nearby generators and sub-transmission lines, indirectly affecting fault levels.

1.5. Operating profile

The CHAR SVC is capable to operate with a nominal swing range of 7Mvar inductive to 10Mvar capacitive however during normal operation, ± 2.4 Mvar is reserved for dynamic/transient response resulting in a reduced range available for steady state voltage control (4.6Mvar inductive to 7.6Mvar capacitive). As can be seen in Figure 4 during high load events the SVC provides capacitance, while Figure 5 shows that during low load events the SVC provides inductance to help manage voltage stability.

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

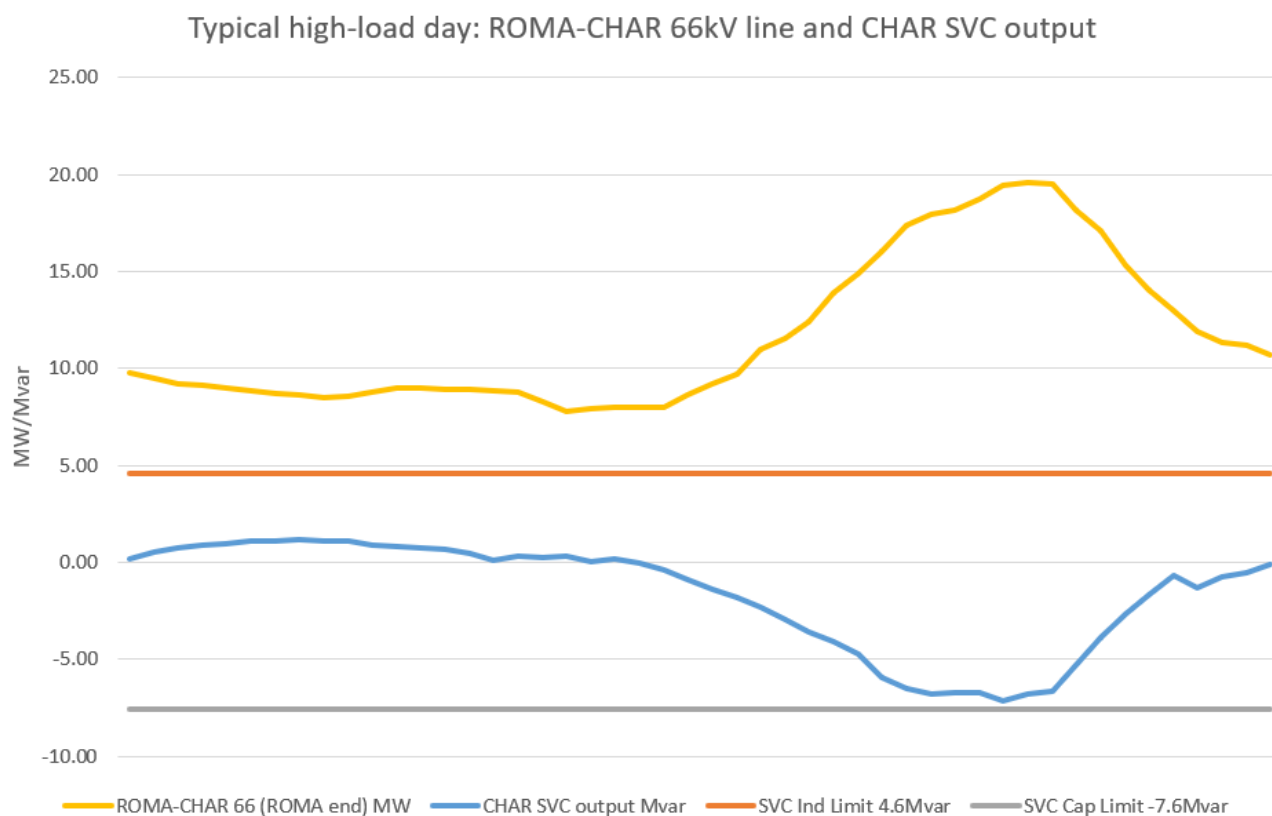


Figure 4 – CHAR SVC and ROMA-CHAR 66kV line loading – Typical high-load day profile (+ve is absorbing reactive power)

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

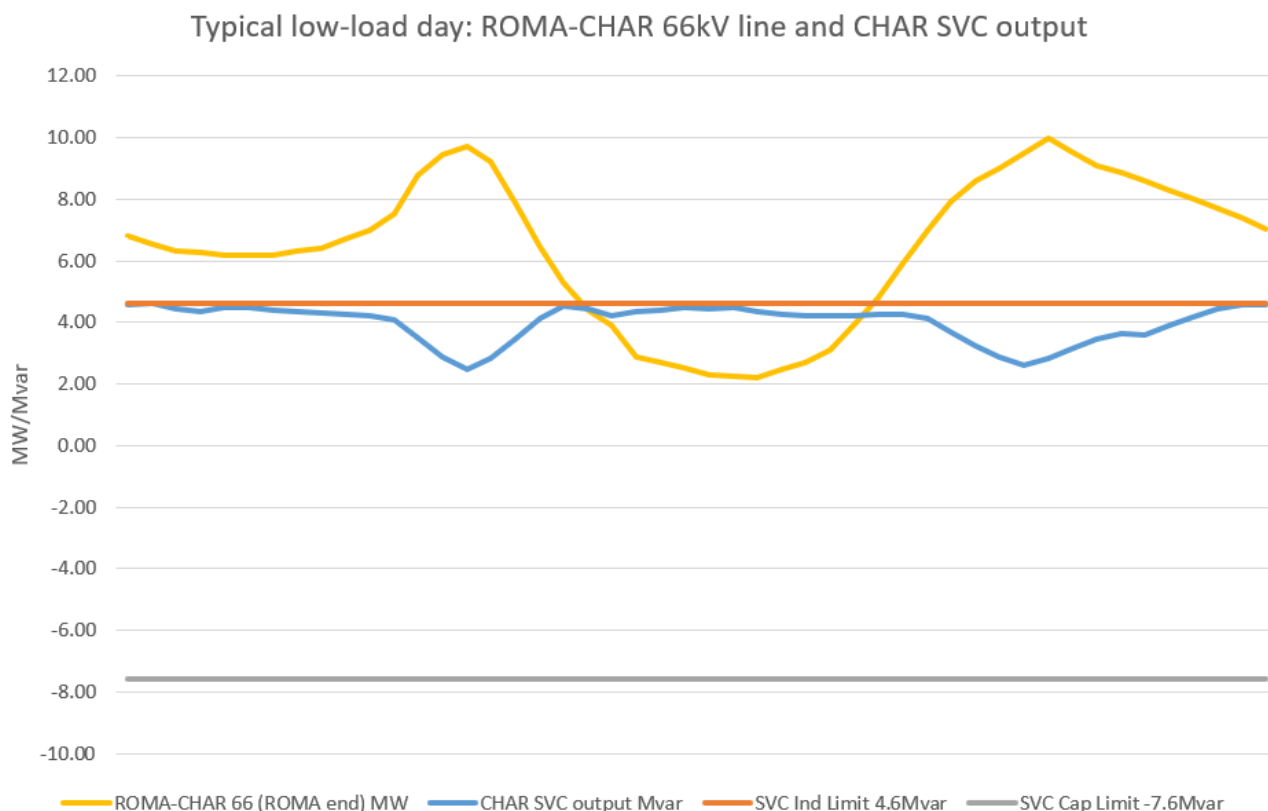


Figure 5 - CHAR SVC and ROMA-CHAR 66kV line loading – Typical low-load day profile (+ve is absorbing reactive power)

1.6. Forecast

The SVC was commissioned in 1991, and this operating range was designed to cater for the existing and forecast demand at the time. Over the life of the SVC, system demand has increased considerably e.g. in 1991 the maximum demand seen by the ROMA-CHAR 66kV line was approximately 12.2MW (as measured from the ROMA end) compared to the peak of 25.7MW recorded in January 2025. At the same time, growth of customer energy resources (CERs) (e.g. rooftop solar PV) has resulted in a decrease in minimum demand. This changing demand profile has increased the reactive power requirements during high and low load times to the extent that the SVC frequently reaches both the capacitive and inductive limits (see Figure 4 and Figure 5).

The network maximum demand forecast is relatively flat, however there is significant CER growth expected within the Charleville, Cunnamulla and Quilpie distribution networks. Large customers in the area are also exploring opportunities to reduce their load with onsite generation. The lowest loads are now seen during the middle of the day, during months with more mild weather conditions (see Figure 6-8 below). In short, it is expected that low-load periods will continue to decline, increasing inductive compensation requirements within the network.

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

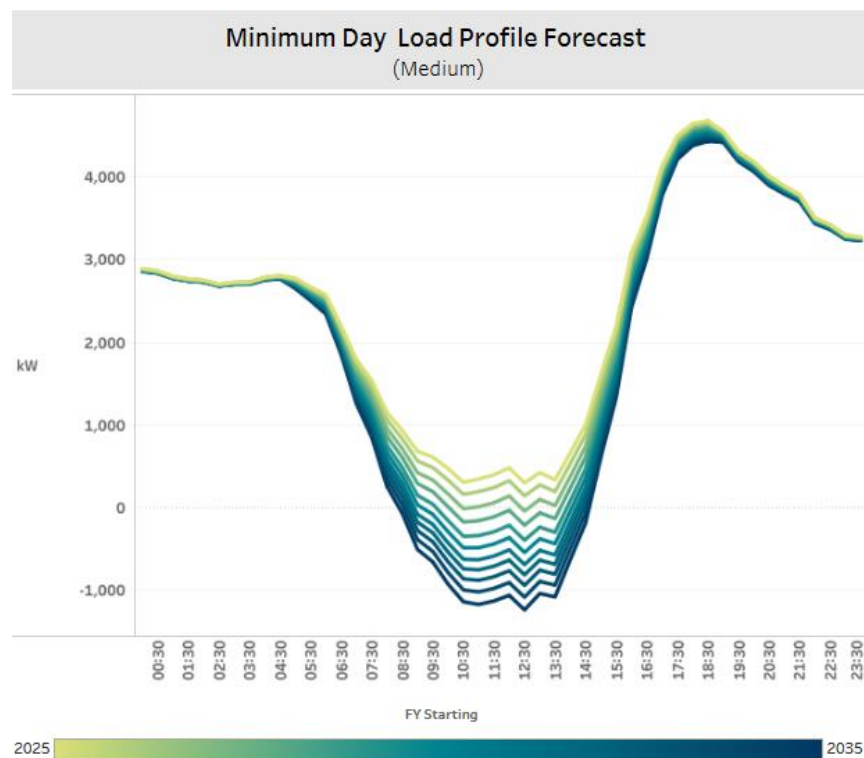


Figure 6 - CHAR minimum day load profile forecast.

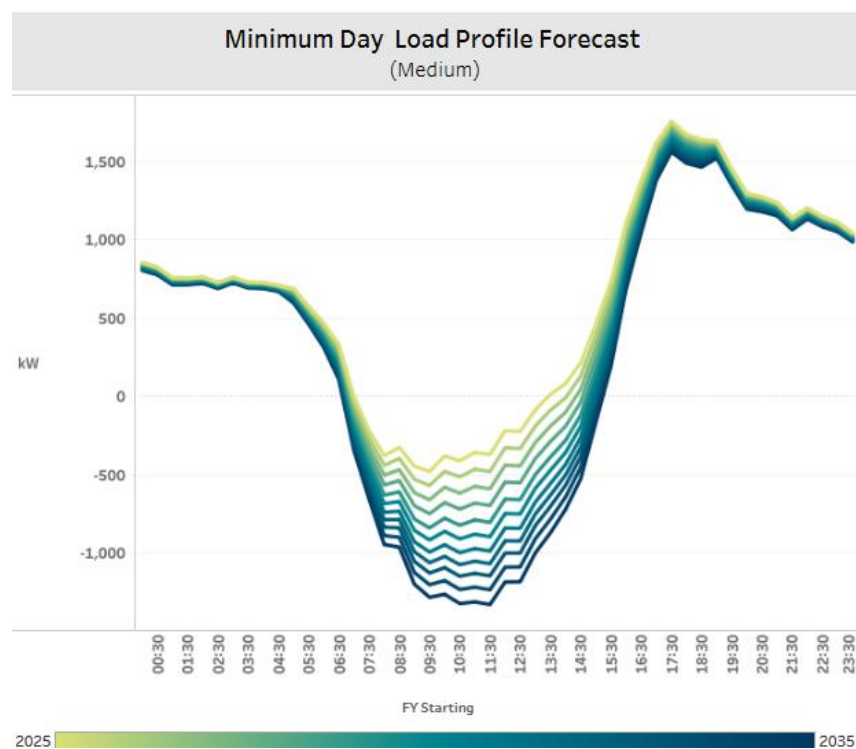


Figure 7 - CUNN minimum day load profile forecast.

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

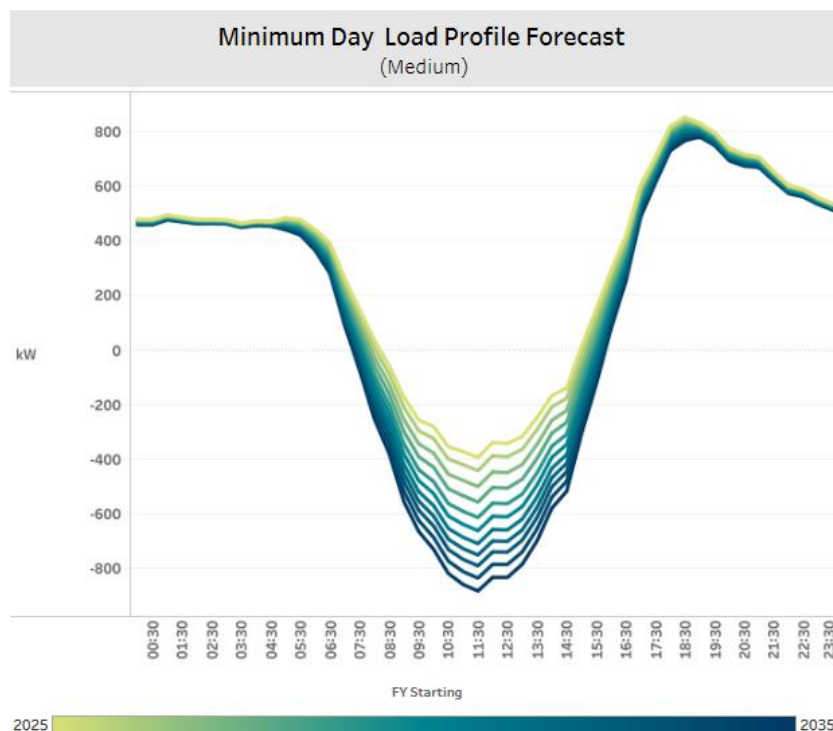


Figure 8 - QUIL minimum day load profile forecast.

1.7. Design Parameters and Specified Performance Levels for Reactive Power Compensation at Charleville

To ensure that a non-network solution meets the NER technical requirements, it must comply with the design parameters and specified performance levels attached in **Appendix A**.

1.8. Size of load reduction or additional supply

Reducing the peak demand of the network would lead to a reduction in the capacitive range of reactive power compensation required. Similarly, inductive compensation requirements might be reduced by adding load to increase the minimum demand profile. However, due to the specific network characteristics (see section 1.3), it is anticipated that there would always be a need for some form of dynamically controlled, reactive power compensation capability within the 66kV network supplying CHAR, CUNN and QUIL.

2. IDENTIFIED NEED

The increasing probability of failure of the SVC is deemed to have reached unacceptably high levels. The assets are in need of replacement. A long-term outage to the SVC would cause a breach of Ergon Energy's regulatory obligations, reliability performance standards and technical requirements (as listed below). As such, Ergon Energy is seeking to undertake reliability corrective action by immediately replacing the SVC in order to ensure continued adherence to these requirements under applicable regulatory instruments.

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

The SVC is operating well beyond its design life and is experiencing an increasing failure rate of its aged components. Due to a lack of inbuilt redundancy within the SVC, the failure of a single component could cause a loss of the full functionality of the SVC. Spare parts are no longer able to be sourced for some of the SVC components, such as the PCB inner loop control cards, and there is a distinct possibility that if a failed card cannot be repaired then the entire SVC would be rendered inoperable and would need to be replaced. In this scenario there would be a long-term outage (i.e. greater than two years) to the SVC while it is replaced. As described in section 1.2, there are customer reliability impacts during a long term outage to the SVC and it is estimated that, depending on the time of the year, up to 10MW of customer load shedding would be required in order to maintain network voltages.

As well as customer reliability impacts, SVC failure would lead to voltage compliance issues on the network. Sub-transmission and distribution voltage levels would not be controlled within statutory planning limits, increasing the risk of network over-voltages, under-voltages and voltage unbalance potentially leading to premature failure of customer appliances and equipment.

Ergon Energy has obligations to comply with the reliability performance standards specified in its Distribution Authority (DA), issued under the *Electricity Act 1994* (Qld) (the Act). If network investment did not occur, this would likely result in breaches of reliability performance obligations under Ergon Energy's DA, namely:

- Clause 7 - Guaranteed Service Levels (reliability of supply)
 - During a long-term, unplanned outage of the SVC, customer load shedding would be required at times in order to maintain voltage stability of the network. The duration of customer supply interruption is likely to exceed the performance levels stipulated within the guaranteed service level regime.
- Clause 8 - Distribution Network Planning
 - This clause states that the distribution entity must plan and develop its supply network in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services. The SVC performs a critical role in maintaining voltages and power transfer capability in the network. Failing to maintain a reliable and secure reactive power capability within the network may be seen as a breach of this clause.
- Clause 9 - Minimum Service Standards
 - During a long-term, unplanned outage of the SVC, rolling customer load shedding would be required at times in order to maintain voltage stability of the network. This would have a large, negative impact on system-wide SAIDI and SAIFI limits stipulated within the Minimum Service Standards.
- Clause 10 - Safety Net
 - A failure of the SVC is deemed to be a credible N-1 contingency in terms of Safety Net planning requirements. A long-term outage to the SVC would result in some customers being unsupplied beyond the 48-hour, full restoration target stipulated within the Schedule 4 Service Safety Net Targets.

Further to the above obligations, section 42(a)(i) of the Act states that distribution entities must comply with the reliability requirements, system standards and performance requirements specified within the National Electricity Rules (NER). Without investing in the network, the following system standards would likely be breached:

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

- Schedule 5.1a System Standards
 - S5.1a.3 System stability
 - S5.1a.4 Power frequency voltage
 - S5.1a.5 Voltage fluctuations
 - S5.1a.6 Voltage waveform distortion
 - S5.1a.7 Voltage unbalance
- Schedule 5.1 Network Performance Requirements
 - S5.1.2 Network reliability
 - S5.1.2.1 Credible contingency events
 - S5.1.4 Magnitude of power frequency voltage
 - S5.1.5 Voltage fluctuations
 - S5.1.6 Voltage harmonic or voltage notching distortion
 - S5.1.7 Voltage unbalance
 - S5.1.8 Stability

The network and regulatory requirement risks described above are based upon the present load profile of the Charleville 66kV network and the current condition of the SVC. As described in section 1.6, the SVC frequently reaches its steady-state capacitive and inductive limits and it is expected that network reactive compensation requirements will increase into the future (particularly in the inductive range). This leads to increasing load at risk and an increasing likelihood of Ergon Energy breaching its regulatory obligations, reliability performance standards and technical requirements. A failure to promptly complete a project to address the SVC asset condition risk is likely to materially affect the reliability and secure operating state of a significant part of the network. Based on this, Ergon Energy seeks to address the identified need by June 2029 which is estimated to be the earliest date that the network option could be implemented (see section 3.1).

As described above, there is underlying customer load at risk that would remain until the identified need is resolved by a credible option. Options that could be implemented promptly would have increased customer reliability benefits (compared to options that took longer to implement) which will be taken into account during the cost-benefit analysis of all credible options.

3. POTENTIAL CREDIBLE OPTIONS

3.1. Credible Options Identified

Ergon Energy has considered all options that could reasonably be classified as a credible option without bias to energy source, technology, ownership and whether it is a network option, a non-network option or a SAPS option.

Ergon Energy has identified two potential credible options that would address the identified need; one of these is a network option and the other a non-network option.

3.1.1. Option A: 10Mvar STATCOM

This option replaces the CHAR SVC with two separate 5Mvar Static Synchronous Compensators (STATCOMs), connected to the 11kV and 22kV buses respectively, and with the capability to be easily expanded up to 7.5Mvar units in the future. The STATCOM system is designed to have N-1

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

redundancy so that it retains at least 50% of its rated capacity in the event of a failure of any single element.

This option is commercially and technically feasible, can be implemented in the timeframe identified and would address the identified need by:

- Providing sufficient inductive and capacitive reactive power capability to manage network voltages at Charleville, Quilpie and Cunnamulla zone substations and surrounding distribution areas.
- Being able to be easily expanded to cater for future load growth and load degradation.
- Providing NPS correction to address voltage balance issues associated with SWER networks.
- Reducing voltage transients caused by inductor or capacitor switching and flicker caused by motor starting currents.
- Meeting Ergon Energy's reliability performance standards as specified in its DA (as described in section 2). This is achieved by providing redundancy to maintain adequate reactive power capability to avoid the need for customer load shedding during any credible contingency to the STATCOM.
- Meeting Ergon Energy's reliability, system standards and performance requirements specified in the NER (as described in section 2).

The estimated capital cost of this option is \$8,455,000 and the estimated operating costs of this option is \$70,000 per annum. The estimated commissioning date of this option is 01/06/2029.

The estimated project schedule is:

Activity	Duration (months)	Planned completion date
RIT-D	6	1/05/2026
Project approval	12	1/05/2027
Detailed design	12	1/05/2028
Construction	12	1/05/2029
Commissioning	1	1/06/2029

The estimated costs comprise the following components:

- financial costs incurred in constructing or providing the credible option (including early engagement on the potential connection requirements and costs of each option) - estimated at \$8,455,000.
- operating and maintenance costs - estimated at \$70,000 per annum.
- costs of complying with relevant laws, regulations and administrative requirements - nil; and
- costs unique to asset replacement projects or programs - nil.

Reliability Corrective Action - The Southwest QLD Network Area

Options Screening Report

Due to Option A's scope of works being entirely contained within the existing CHAR site, as well as the expected reliability and safety benefits of this option to the local community, there are not expected to be any social licence issues that would require additional costs to manage or increase the delivery timeline of this option.

3.1.2. Option B: Network Support Arrangement for the provision of reactive power via an external provider

This option is for an external party to provide reactive power compensation, via a network support arrangement, sufficient to meet Ergon Energy's ongoing operational requirements. This would require a minimum of $\pm 10\text{Mvar}$ of reactive power support with the ability to be easily expanded to $\pm 15\text{Mvar}$ if required in the future.

To meet Ergon Energy's reliability performance standards and technical performance requirements, it is anticipated that this solution would be split into a minimum of two $\pm 5\text{Mvar}$ units connected by separate substation circuit breakers, to ensure adequate redundancy of reactive power capability in the event of a credible contingency. For example, a technically feasible solution might be to provide $\pm 5\text{Mvar}$ on each of the 22kV bus and 11kV bus at CHAR for a total substation capacity of $\pm 10\text{Mvar}$.

Ergon Energy however, is also willing to consider other connection arrangements as may be proposed, such as connection at 66kV, and other credible solutions which may be identified as part of this RIT-D process such as solutions that reduce the level of reactive power compensation required within the network, for example, by importing or exporting power at the connection point to optimise the system load profile.

It is anticipated that such a solution could potentially be implemented in the timeframe identified, depending on the solutions proposed and any subsequent commercial negotiations. Such an option may be commercially and technically feasible and address the identified need by:

- Providing sufficient inductive and capacitive reactive power capability to manage network voltages at Charleville, Quilpie and Cunnamulla zone substations and surrounding distribution areas.
- Being able to be easily expanded to cater for future load growth and load degradation.
- Providing NPS correction to address voltage balance issues associated with SWER networks.
- Reducing voltage transients caused by inductor or capacitor switching and flicker caused by motor starting currents.
- Meeting Ergon Energy's reliability performance standards as specified in its DA (as described in section 2). This is achieved by providing redundancy to maintain adequate reactive power capability to avoid the need for customer load shedding during any credible contingency to the external providers system.
- Meeting Ergon Energy's reliability, system standards and performance requirements specified in the NER (as described in section 2).

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

It is expected that any proposed solution for this option would be designed and maintained in accordance with good electricity industry practice, such that a high reliability and availability solution is delivered.

The capital cost of this option, inclusive of network connection costs, is estimated between \$9,100,000 and \$31,400,000 and the estimated operating costs of this option would be between \$70,000 and \$196,000 per annum.

The large variance in estimated costs reflects the range of technically feasible options along with the variance of scope of works required by the different plant types and configurations that might form a proposed solution.

The costs involved in connecting a non-network option are highly dependent on the specifics of the proposal. Connection costs, including any potential costs involved in upgrading the Ergon Energy network, will be estimated by the cost benefit analysis.

Any HV connected generation solution would be expected to meet the Ergon Energy Standard STNW1175 (Standard for High Voltage EG Connections)¹. For example, a solution that establishes a new > 5MW inverter-based generator would be capable of supplying additional fault current into the network which would require a substantial upgrade to the protection schemes² at CHAR and ROMA to accommodate. Whereas a solution such as a STATCOM (without any generation) does not supply additional fault current and would have much lower protection requirements³.

4. SOCIAL LICENCE AND COMMUNITY ENGAGEMENT

4.1. Social Licence

Ergon Energy has not, at this stage, identified any social licence considerations that have affected the identification and selection of credible options to address the identified need.

4.2. Community Engagement

As the scope of works for Option A will not extend into new areas of the community and will be entirely contained within the existing site owned by Ergon Energy, it is not expected to cause any disruption to the community at large. As a result, we have not identified any community stakeholders who might reasonably be expected to be affected by the development of this option.

As the scope of works for Option B is not currently known and will be unique to each non-network option proposed, Ergon Energy is not currently able to determine whether there are likely to be any

¹ Available from: https://www.ergon.com.au/__data/assets/pdf_file/0020/1072550/Standard-for-High-Voltage-EG-Connections-2946177.pdf

² As per connection requirements under NER Chapter 5.

³ As per connection requirements under NER Chapter 5A.

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

community stakeholders who would be reasonably expected to be affected by the development of the project.

While Ergon Energy does not anticipate any community stakeholder concerns, should any be identified, these would be addressed as part of the Ergon Energy Community Engagement Framework which is integrated into the project workflow.

5. INFORMATION TO ASSIST NON-NETWORK PROVIDERS WISHING TO PRESENT ALTERNATIVE POTENTIAL CREDIBLE OPTIONS

Ergon Energy engages with customers and demand management providers to develop and implement demand side, non-network and SAPS solutions in accordance with our Industry Engagement Document.⁴

Ergon Energy invites written submissions, identifying additional options to address the identified need, from registered participants, AEMO, interested parties, non-network providers and persons registered on Ergon Energy's Industry Engagement Register.

Identifying additional options should predominately occur at this stage of the RIT-D process. All submissions that propose new potential credible options should include sufficient technical and financial information to enable Ergon Energy to undertake comparative analysis of the proposed solution against other options, to ensure that it addresses the identified need, is technically and commercially viable and is able to be implemented in sufficient time to address the identified need.

The proposals should include, but are not limited to, at least the following:

- Full capital and operating costs. This includes the whole of life costs of constructing or providing the credible option, excluding the connection costs.
- Proposed network support contract costs.
- An estimate of the market benefits arising as a consequence of the operation of the non-network option, e.g. as a result of the impact of the non-network option on the operation of the wholesale and/or ancillary services markets.
- Project execution strategy including design, testing and commissioning plans.
- Engineering network system studies and study reports.
- Verified and approved engineering designs.

Ergon Energy will not be legally bound in any way or otherwise obligated to any person who may receive this Report or to any person who may submit a proposal. At no time will Ergon Energy be liable for any costs incurred by a proponent in the assessment of this Report, any site visits,

⁴ Available at: <https://www.ergon.com.au/network/manage-your-energy/managing-electricity-demand/industry-engagement>

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

obtainment of further information from Ergon Energy or the preparation by a proponent of a proposal to address the identified need specified in this Report.

The selection of any non-network solution to address the identified need will be done in accordance with the Energy Queensland Procurement Policy⁵.

Submissions in writing are due by 4pm on the 23/01/2026 and should be lodged to demandmanagement@ergon.com.au

⁵ Available at: <https://www.ergon.com.au/network/contractors/working-with-us/tenders/procurement-and-purchasing-terms>

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

6. COMPLIANCE STATEMENT

This Report complies with the requirements of clause 5.17.4(e) of the NER as demonstrated below:

Requirement	Report Section
(1) a description of the identified need;	2
(2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, why the RIT-D proponent considers reliability corrective action is necessary;	2.1
(3) if available, the relevant annual deferred <i>augmentation</i> charge associated with the identified need;	N/A
(4) the technical characteristics of the identified need that a non-network option would be required to deliver, such as: (i) the size of <i>load</i> reduction or additional <i>supply</i> ; (ii) location; (iii) contribution to <i>power system security or reliability</i> ; (iv) contribution to <i>power system</i> fault levels as determined under clause 4.6.1; and (v) the operating profile;	1, Appendix A
(5) a summary of potential credible options to address the identified need, as identified by the RIT-D proponent, including network options and non-network options;	3
(6) for each potential credible option, the RIT-D proponent must provide information, to the extent practicable, on: (i) a technical definition or characteristics of the option; (ii) the estimated construction timetable and commissioning date (where relevant); and (iii) the total indicative cost (including capital and operating costs); and	3
(7) information to assist non-network providers wishing to present alternative potential credible options including details of how to submit a non-network proposal for consideration by the RIT-D proponent.	5

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

7. APPENDIX A – DESIGN PARAMETERS AND SPECIFIED PERFORMANCE LEVELS FOR REACTIVE POWER COMPENSATION AT CHARLEVILLE

All plant and systems supplied under this proposal are required to be designed with respects to the following parameters:

Table 1 – Charleville 66/22/11kV Substation Environmental Conditions

Item	Particular	Details
1.1	Altitude	1000 metres above sea level
1.2	Ambient temperature	50°C summer daytime (maximum) -5°C winter night-time (minimum) AS 2067 2.4.3.4 “very hot climates”
1.3	Humidity	100% (maximum) 25% (minimum)
1.4	Isokeraunic level	Ergon Energy standards and AS1768 must be applied for lightning protection design.
1.5	Pollution	Site pollution severity class d (Heavy) in accordance with SA TS60815.1
1.6	Rainfall intensity	Five-minute duration 350 mm/h
1.7	Solar radiation (maximum)	1100 W/m ² AS 2067 normal
1.8	Wind velocity	Wind load in accordance with (AS/NZS 1170.2, 2021) as follows: • Annual probability 1:2000 • Terrain Category 2 • Shielding Multiplier 1.0 • Topographical Multiplier to suit site • Region C with V2000 Wind gust speed 260 km/h (72 m/s)

Table 2 – Charleville 66/22/11kV Substation System Conditions

Item	Description	Rating
2.1	Highest voltage, under normal system conditions, for equipment with nominal voltage from 1kV up to 35kV	Per Table 3 of AS 60038-2022
2.2	Highest voltage, under normal system conditions, for equipment with nominal voltage above 35kV and not exceeding 230kV	Per Table 4 of AS 60038-2022

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

Table 3 - Charleville 66/22/11kV Substation Fault Levels

System Configuration	Fault Location	Fault Type	Network Fault Current Contribution at Fault Location (kA)
Existing <i>distribution system</i> – system normal	CHAR 11kV Bus	3 ϕ - Maximum	1.50
		1 ϕ -g - Maximum	2.12
		3 ϕ - Minimum	1.26
		1 ϕ -g - Minimum	1.79
Existing <i>distribution system</i> – N-1 condition (CHAR T1 Out of Service)	CHAR 11kV Bus	3 ϕ - Minimum	1.06
		1 ϕ -g - Minimum	1.51
Existing <i>distribution system</i> – system normal	CHAR 22kV Bus	3 ϕ - Maximum	0.75
		1 ϕ -g - Maximum	1.00
		3 ϕ - Minimum	0.63
		1 ϕ -g - Minimum	0.85
Existing <i>distribution system</i> – N-1 condition (CHAR T2 Out of Service)	CHAR 22kV Bus	3 ϕ - Minimum	0.53
		1 ϕ -g - Minimum	0.73
Existing <i>distribution system</i> – system normal	CHAR 66kV Bus	3 ϕ - Maximum	0.32
		1 ϕ -g - Maximum	0.14
		3 ϕ - Minimum	0.26
		1 ϕ -g - Minimum	0.12
Existing <i>distribution system</i> – N-1 condition (ROMA T1 Out of Service)	CHAR 66kV Bus	3 ϕ - Minimum	0.24
		1 ϕ -g - Minimum	0.12

- *Maximum and minimum fault levels are sourced from the published 2025 Ergon Energy Fault Level Summary Report. The information obtained from the report is intended as general in nature, may be based on assumptions that change with time and may not necessarily be complete. Information contained in, or obtained from, the report should not be relied upon, and use of the information contained in the report is at your own risk.*
- *Fault summaries were performed in Powerfactory with fault level calculation method IEC 60909.*
- *For minimum faults:*
 - *The network model used included the full PSSE snapshot (minimum fault level case uses a minimum dispatch scenario with all asynchronous generation offline as provided by Powerlink Queensland) of the NEM, with the addition of all of the relevant Ergon Energy network.*
- *For maximum faults:*
 - *Maximum fault levels are produced based on all network elements being ‘intact’; where normally open switches, circuit breakers, and isolators are closed within the boundary of a substation to produce the maximum fault levels results for that substation, except where indicated in the report. This assumption can result in short circuit current appearing to be higher at some locations compared to its system normal fault level configuration.*

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

Table 4 lists the Specific Performance Levels required for the proposed solution. Note that additional performance levels and technical requirements might also apply, depending on the type/size of plant used in the solution and the specific connection arrangement. E.g. a HV connected renewable generation solution would be expected to meet Ergon Energy Standard STNW1175 (Standard for High Voltage EG Connections) as well as these Specific Performance Levels.

Table 4 - Specific Performance Levels for Reactive Power Compensation at Charleville

Item	Description	Rating
4.1	Likely frequency for which the reactive power support is expected to be dispatched	Continuously 24 h x 365 days / year
4.2	Maximum time taken to become fully available to provide the service following a 66kV circuit breaker reclose event at Roma	0 s (must remain operational following a reclose event and ride through other dips or transients)
4.3	Minimum continuous reactive power capability range at connection point: 0.9 - 1.1 pu voltage, frequency 49.75 to 50.25 Hz at Charleville substation	± 10 Mvar (10 Mvar Inductive to 10 Mvar Capacitive)
4.4	Capability for system to be easily expanded in the future if required	Expandable to ± 15 Mvar
4.5	Redundancy of system design	System must retain 50% of reactive power capacity in the event of a single failure of any system element ($N - 1$)
4.6	Be capable, on receipt of appropriate input signals, of changing its output from fully inductive to fully capacitive	≤ 40 ms
4.7	Capability of continuous uninterrupted operation during and following a system voltage disturbance e.g. a load reduction event	Capable of continuous operation for voltage changes of up to 30% from its pre-disturbance level
4.8	Black-start capability	System must be able to provide reactive power support during re-energisation of the 66kV line from Roma
4.9	Average Annual Availability (*)	99.81% (8743 h / yr)

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

	$\% \text{ Availability} = \frac{\text{Total Time VCNSS is able to Perform Specific Performance Levels}}{\text{Total Time Period}}$	
4.10	Maximum percentage Downtime (**) $\% \text{ Downtime} = \frac{\text{Total Downtime}}{\text{Total Time Period}} \times 100$ also, $\% \text{ Downtime} = 100 - \% \text{ Availability}$	0.19% (17 h / yr)
4.11	Maximum number of downtime events	1 / yr
4.12	System voltage at point of connection	
	a. Nominal system voltage	66kV / 22kV / 11kV
	b. Voltage range for continuous operation	0.9 to 1.1 pu of nominal
4.13	Measurement accuracy for voltage transformers	Class 0.5M
4.14	Allowable Droop Settings	
	a. Boost	0% to 10%, 0.1% increment
	b. Buck	0% to 10% 0.1 % increment
	c. Voltage Dead band	0 to ± 0.1 pu 0.001 pu increment
4.15	Required to ride through and operate to the expected performance levels during and following power system voltage, frequency and voltage/current waveform disturbances some of which may occur simultaneously as follows:	
	a. Maximum temporary voltage (30 sec)	1.30 pu V
	b. Minimum temporary voltage (30 sec)	0.70 pu V
	c. Long term over-voltage (1800s)	1.15 pu V

Reliability Corrective Action - The Southwest QLD Network Area

Options Screening Report

	d. Short term over-voltage (0.2s)	1.50 pu V
	e. A drop in one or more phases of the voltage at the point of connection	0.5 pu V for 0.6 sec
	f. Voltage oscillating (at a frequency of ± 0.25 to ± 2.5 Hz)	0.7 to 1.3 pu V
	g. Worst asymmetrical faults to be expected at 66 kV bus	0.25 pu V
	h. Worst asymmetrical faults to be expected at 22 kV bus	0.33 pu V
	i. Worst asymmetrical faults to be expected at 11 kV bus	0.33 pu V
	j. A switching surge of 2.2 pu at the connection point	Up to 20 msec
	k. A fall in system frequency to 46.5 Hz, with recovery to 46.5 – 52.5 Hz	Within 4 minutes
	l. High speed autoreclose	
	i. Dead time	5 – 15 s
	ii. Reclaim time	20 s
4.16	Maximum allowable reactive power step	0.03 pu
4.17	System frequency at point of connection	
	a. Nominal frequency	50 Hz
	b. Normal control range	49.75 - 50.25 Hz
	c. Transient excursions (less than 10 minutes)	49.0 - 51.0 Hz
	d. Transient excursions (less than 2 minutes)	46.5 - 52.5 Hz
4.18	Maximum equipment design fault currents	
	a. 66kV	25kA rms for 3 s
	b. 22kV	25kA rms for 3 s
	c. 11kV	25kA rms for 3 s
4.19	Negative Phase Sequence Control	
	a. Minimum reactive power required, per phase, for individual phase control.	1/3 of ± 10 Mvars
	b. Typical dead band setting	0 - 10%
	c. Deadband setting range	4%
4.20	Power System Monitoring	
	a. Power Quality Measurement System	Relevant IEC Standards Up to 100 th Harmonics
	b. High Speed Fault Recorder System (multi-channels)	Up to 24kHz per channel
	c. Synchrophasor Measurement Units (PMU)	Per Standard IEC / IEEE 60255-118-1:2018
4.21	Maximum allowable sound pressure levels at one metre outside VCNSS perimeter fence	55 dBA

Reliability Corrective Action - The Southwest QLD Network Area Options Screening Report

4.22	Maximum Radio Interference Voltage outside of the VCNSS perimeter fence.	500 μ V
4.23	Maximum Allowable Electric Field	
	a. Occupational for the whole working day	10 kV/m
4.24	Maximum Allowable Magnetic Field	
	a. Occupational for the whole working day	10,000 mG

(*) The system is considered to be available for service only if it is able to perform the whole of the specified duty. Operation with limited control functions or within a limited range of outputs not meeting the specified levels due to a component, software or subsystem failure is to be treated as unscheduled servicing downtime.

(**) Total Downtime within a Total Time Period is defined as the sum of the scheduled service downtime and unscheduled service downtime.