Part of Energy Queensland

Request for Proposal Charleville 66kV Voltage Management

Version 1.0

Consultation Period Start: 01/10/2021
Consultation Period Finish: 17/12/2021

EXECUTIVE SUMMARY

This Request for Proposal (RFP) document is an invitation to proponents to submit a non-network, Volt-var Control Network Support Service (VCNSS) solution to address Charleville 66kV Voltage Management identified in the Ergon Energy South West Area Network at Charleville. This RFP provides:

- Background information on the network limitation.
- An invitation to submit credible non-network options
- The non-network solution technical requirements; and
- Information on what to include in your submission.

Network Need:

Ergon Energy Corporation Limited (Ergon Energy) is part of Energy Queensland and is responsible (under its Distribution Authority) for electricity supply to the Charleville, Quilpie and Cunnamulla area in south west Queensland. The Charleville zone substation contains an aging static var compensator (SVC) which is connected to its 11kV bus. The SVC is set up to control the 66kV bus voltage and has a range of 7Mvar inductive to 10Mvar capacitive. The SVC also provides Negative Phase Sequence (NPS) correction to address voltage balance issues associated with Single Wire Earth Return (SWER) networks. The Charleville SVC is approaching the end of its design life and it is recommended for replacement because of its age and reliability before the end of 2023/24 FY.

History:

Ergon Energy previously sought to address the Charleville 66kV Voltage Management Limitation through the RIT-D process:

- 12/01/2018: NNOR published
- 26/07/2018: DPAR published
- 22/05/2019: FPAR published

The preferred option identified in the FPAR is Option C – A Network Support Agreement to provide reactive power via an external provider. This RFP seeks to implement the preferred option by inviting proponents to submit a non-network VCNSS solution.

Non-Network Options:

To be considered a viable option, any proposed solution must be technically feasible, commercially feasible; and able to be implemented in enough time for deferral of the network investment. A non-network solution must provide an option that fully services the network limitation, for 20 years.

Required:

The required characteristics of any non-network solution are summarised in the Technical Requirements section of this document below:

Submissions:

Ergon Energy is seeking submissions from proponents on potential credible options to address the replacement of the SVC network constraint in the Charleville zone substation. Only submissions received by 4 pm December 17, 2021 will be accepted. Submissions will need to address the issues described in the RFP and are to be submitted to demandmanagement@ergon.com.au.

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1.0 Background

Ergon Energy Corporation Limited (Ergon Energy) is part of Energy Queensland and is responsible (under its Distribution Authority) for electricity supply to the Charleville, Quilpie, and Cunnamulla area in south west Queensland.

Charleville is located in the Maranoa area of the South West Region of Ergon Energy's Network. The Charleville area is supplied via a single 276km 66kV sub-transmission Feeder from T83 Roma Bulk Supply Point (ROMA) and customers in Quilpie and Cunnamulla are supplied via separate 200km long 66kV feeders from Charleville. Distribution supply from Charleville and Cunnamulla is at 11kV for urban, and 22kV and 19.1kV single wire earth return (SWER) for more rural customers. Supply from Quilpie zone substation is exclusively 11kV with extensive 19.1kV SWER networks. Charleville substation contains 1 x 66/11kV transformer, 1 x 66/22kV transformer, and a 22/11kV transformer to link the 22kV and 11kV busbars and hence provide backup for each of the 66kV transformers. The Charleville zone substation contains a static var compensator (SVC) which is connected to its 11kV bus. The SVC is set up to control the 66kV bus voltage and has a range of 7Mvar inductive to 10Mvar capacitive. The SVC also provides Negative Phase Sequence (NPS) correction to address voltage balance issues associated with SWER networks.

Figure 1.1 below shows the sub-transmission infrastructure in the area and the location of Charleville substation.

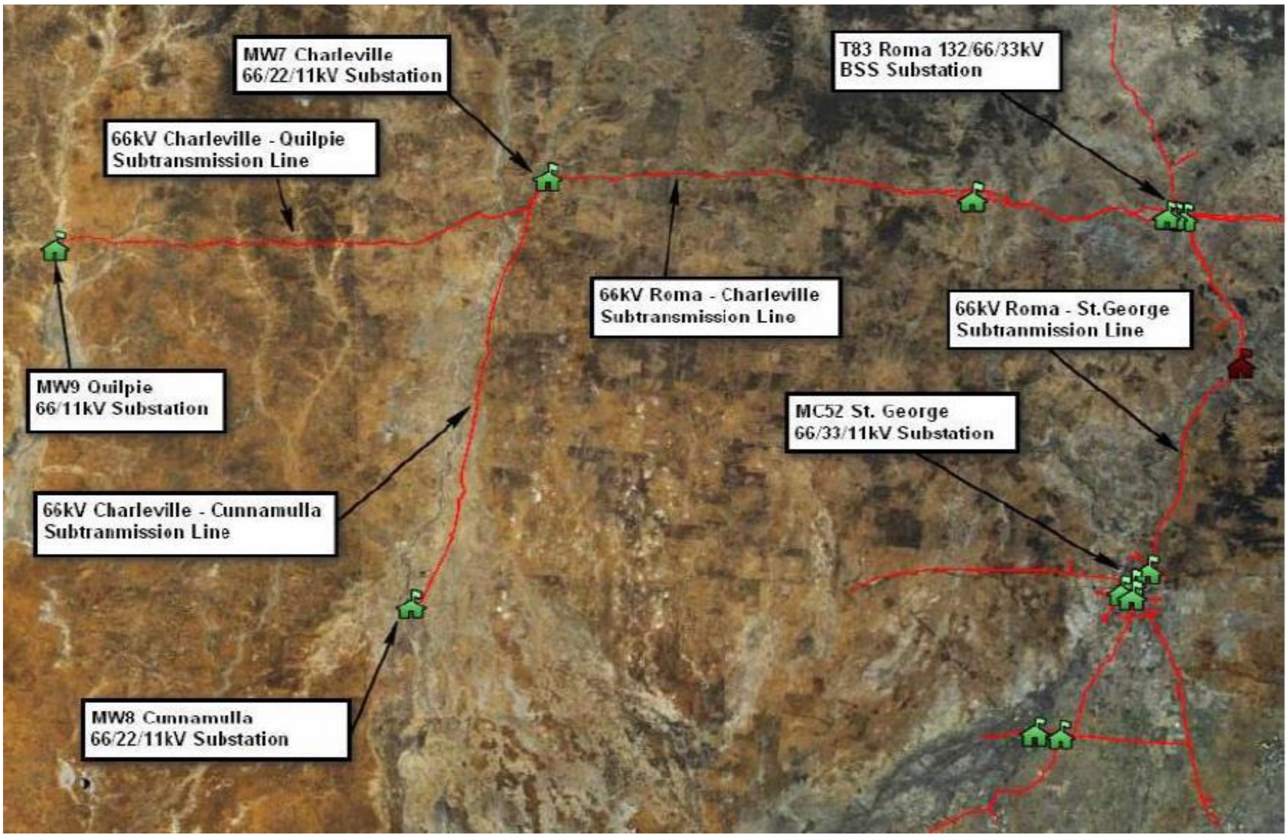


Figure 1.1 - Charleville Sub transmission System

2.0 Current Issues

The Charleville SVC is approaching the end of its design life and it is recommended for replacement because of its age, condition and reliability. The SVC currently provides reactive compensation at Charleville maintaining stable voltages at both high and low load times. Without reactive compensation at Charleville, 66kV supply at Charleville and the far south western Queensland distribution system suffers from poor voltage regulation. This may lead to voltage compliance issues, customer complaints, loss of revenue and operational constraints. During SVC outages, the 66kV bus voltage is regulated by manual switching of reactors, capacitors and transformer taps, some of which are approaching end of life. The process is complex, inefficient, and unacceptable due to large voltage steps occurring , causing over-voltages and under-voltages, on low fault level network of the south west Queensland distribution system.

2.1 Charleville SVC Insufficient Reactive Power Capability

The existing SVC has a total capacitive range of 10Mvar and a total inductive range of 7Mvar. Of the 10Mvar capacitive range, only 7.6Mvar is available for steady state correction with the remaining 2.4Mvar reserved for dynamic/transient response. Similarly, for the 7Mvar inductive range, only 4.6Mvar is available for steady state correction with the remaining 2.4Mvar reserved for dynamic/transient response. The existing SVC is regularly hitting its steady state capacitive and inductive limits and any changes in the network that will increase peak load or decrease the minimum load could drive the need to increase the size of the SVC replacement.

2.2 Growth of Distributed Energy Resources

There is significant amount of Distributed Energy Resources (e.g. rooftop solar PV) installations within the Charleville area network and this is expected to continue to grow. 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 2.1 and Figure 2.2 below). In short, it is expected that low load periods will continue to decline putting additional pressure on inductive compensation.

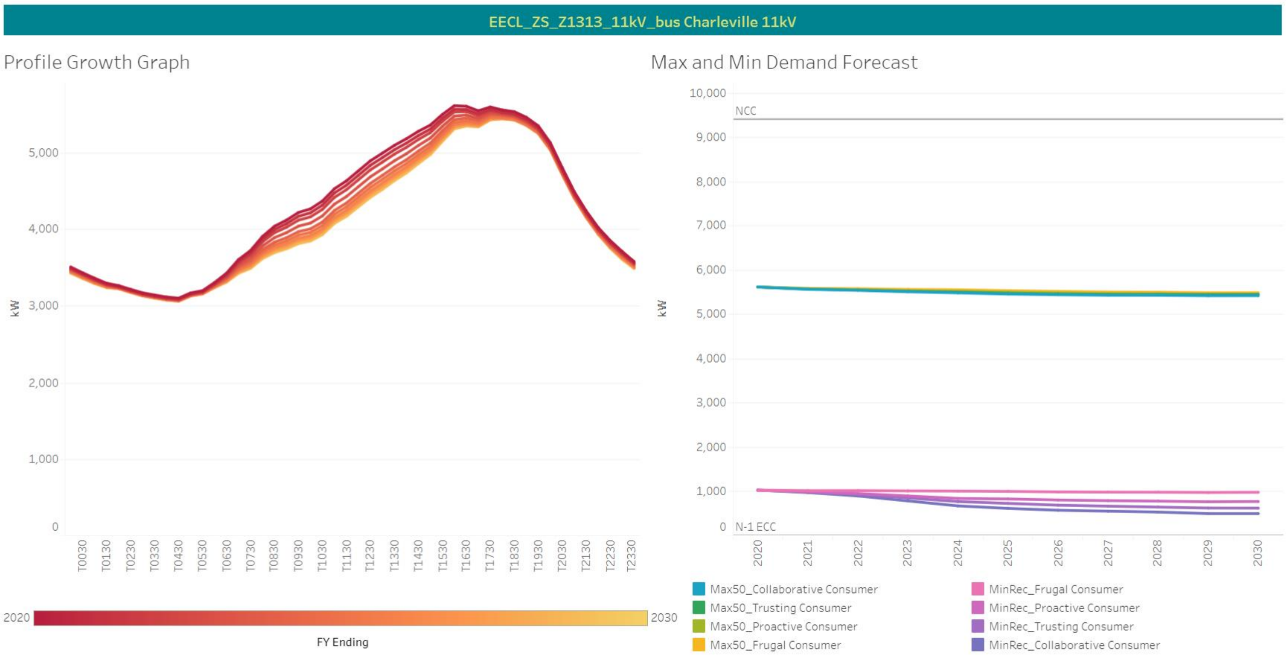


Figure 2.1 – Charleville 11kV bus profile growth and Max. / Min. Demand Forecast

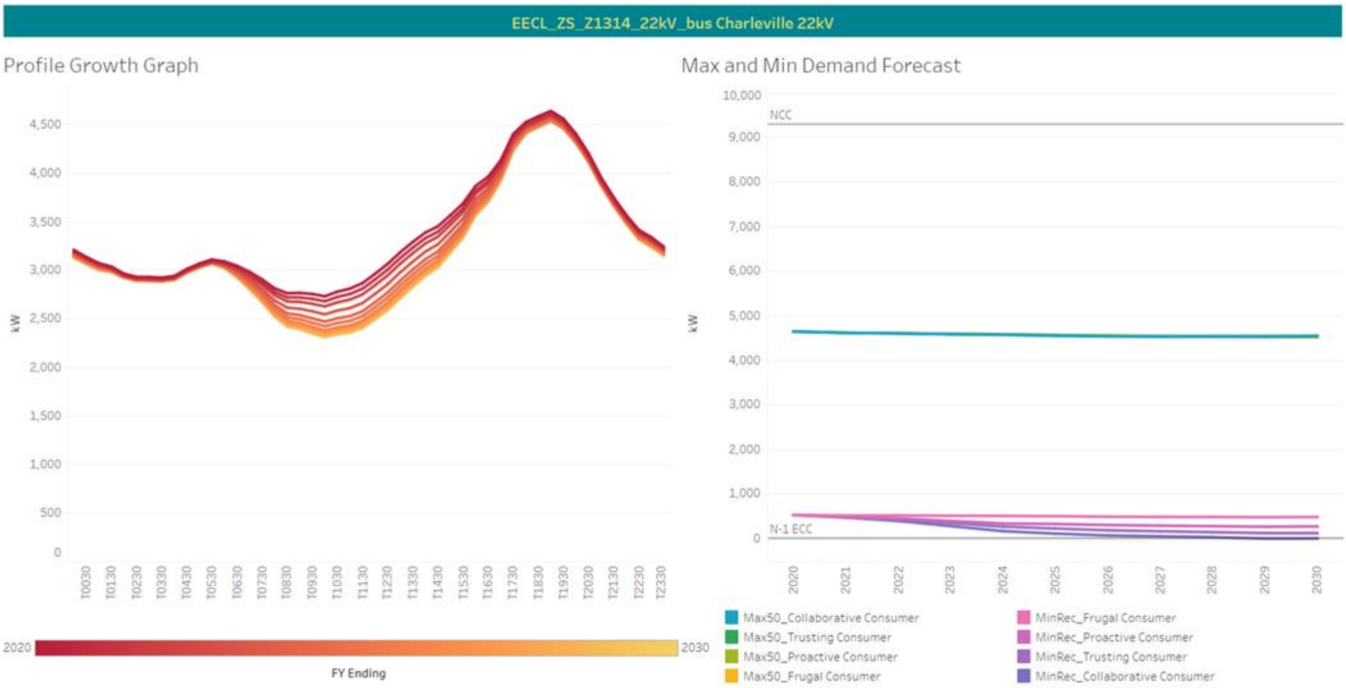


Figure 2.2 - Charleville 22kV bus profile growth and Max. / Min. Demand Forecast

3.0 Volt-var Control Network Support Service Needs

Ergon Energy is requesting proposals for the provision of a Volt-var Control Network Support Service (VCNSS) that can provide equivalent functions and performances to the existing SVC to enable the SVC to be retired from service. The VCNSS solution shall be capable of absorbing and generating reactive power in order to regulate both positive and negative phase sequence (PPS and NPS) voltages at the points of connection to meet the Specific Performance Levels given in Table 6.4 below.

The service shall be suitably located (electrically) to manage Charleville's 66kV busbar voltage during both low and high load periods. Parties interested in providing this Service must have the capability and relevant experience to provide at least ±10Mvar (2 of ±5Mvar) or equivalent and should ideally be able to be expanded to ±15Mvar (2 of ±7.5Mvar) or equivalent pending possible load growth and voltage constraints beyond 2024. For reliability purposes, it is desirable to have the vars split and provided equally on different substation circuit breakers i.e., ±5Mvar on the 11kV bus and ±5Mvar on the 22kV bus. Other connection arrangements can also be considered such as ±10Mvar on the 66kV bus.

4.0 Purpose and Scope of VCNSS Request for Proposal

Ergon Energy calls for Request for Proposal (RFP) for the provision of Non-network VCNSS at Charleville 66/22/11kV substation.

The main purpose of this document, RFP pre-qualification technical specification, is to assist Ergon Energy to select competent non-network solution providers to propose a non-network solution for VCNSS at Charleville substation.

The procurement process for VCNSS consists of key stages listed in Table 4.1 below:

Stages	Description of RFP Process	Preliminary Timeline
1	Issue request for RFP	October 1, 2021
2	RFP submissions close	17 December 2021 (11 weeks)
3	Evaluate RFP submissions of competent non-network solution providers produce a shortlist of qualified proponents	January 28,2022 (6 weeks)
4	Issue Invitation for final submissions to Short-listed Pre-qualified Proponents	April 8, 2022(10 weeks)
5	Evaluate proposals	June 17, 2022 (10 weeks)
6	Notify preferred VCNSS partner	August, 12,2022 (8 weeks)
7	Contract finalised and executed *	November 4, 2022(12 weeks)
8	Selected Partner successfully completes Ergon customer connection process prior to NSA commencement date **	12 months - 24 months

Table 4.1- The process for VCNSS

* to progress to contract stage the selected partner submission must provide a greater net economic benefit than the preferred network option. Refer 13.0 *Submissions from Solution Providers*

** successful completion of Ergon customer connection process will make up a "condition precedent" of the NSA.

5.0 Site Specific Conditions

5.1 Environmental Conditions

All materials supplied under this specification that are installed outdoors are required to withstand the environmental conditions detailed in *Table 5.1*.

Item	Particular	Details
5.1.1	Altitude	Less than 1000 metres above sea level
5.1.2	Ambient temperature	50°C summer daytime (maximum) -5°C winter night-time (minimum)
5.1.3	Humidity	100% (maximum) 25% (minimum)
5.1.4	Isokeraunic level	40
5.1.5	Pollution	Level IV – Very Heavy in accordance with (AS 4436, 1996)
5.1.6	Precipitation	Tropical summer storms with high wind speed and annual rainfall in excess of 2000mm
5.1.7	Solar radiation (equivalent to a black body temperature of 80˚C)	1100 W/m^2
5.1.8	Wind velocity	Wind load in accordance with (AS/NZS 1170.2, 2011) as follows: • Annual probability 1:2000 • Region A with V2000 • Terrain Category 2 • Shielding Multiplier 1.0 • Topographical Multiplier to suit site • Wind gust speed 172 km/h (48 m/s)

Table 5.1- Environmental Conditions

5.2 Power System Existing Conditions

Item	Description	Rating
5.2.1	Highest voltage, under normal system conditions, for equipment with nominal voltage from 1kV up to 35kV	Per Table 3 of AS 60038-2012
5.2.2	Anticipated Short Circuit Power at 66kV bus (MVA)	
	a. Maximum:	36.81 MVA
	b. Minimum	29.92 MVA
5.2.3	Anticipated Short Circuit Power at 22kV bus (MVA)	
	c. Maximum:	30.83 MVA
	d. Minimum	23.95 MVA
5.2.3	Anticipated Short Circuit Power at 11kV bus (MVA)	
	e. Maximum:	30.88 MVA
	f. Minimum	24.06 MVA

Table 5.2 – Charleville 66/22/11kV Substation System Conditions

System Configuration	Fault Location	Fault Type	Network Fault Current Contribution at Fault Location (kA)
Existing *distribution system* – system normal	CHAR 11kV Bus	3ϕ - Maximum	1.62
		1ϕ-g - Maximum	2.21
		3ϕ - Minimum	1.26
		1ϕ-g - Minimum	1.72
Existing *distribution system* – N-1 condition (CHAR T1 Out of Service)	CHAR 11kV Bus	3ϕ - Minimum	1.07
		1ϕ-g - Minimum	1.18
Existing *distribution system* – system normal	CHAR 22kV Bus	3ϕ - Maximum	0.81
		1ϕ-g - Maximum	1.18
		3ϕ - Minimum	0.63
		1ϕ-g - Minimum	0.86
Existing *distribution system* – N-1 condition (CHAR T2 Out of Service)	CHAR 22kV Bus	3ϕ - Minimum	0.54
		1ϕ-g - Minimum	0.79
Existing *distribution system* – system normal	CHAR 66kV Bus	3ϕ - Maximum	0.32
		1ϕ-g - Maximum	0.14
		3ϕ - Minimum	0.26
		1ϕ-g - Minimum	0.12
Existing *distribution system* – N-1 condition (ROMA T1 Out of Service)	CHAR 66kV Bus	3ϕ - Minimum	0.25
		1ϕ-g - Minimum	0.05

Table 5.3 - Charleville 66/22/11kV Substation Fault Levels

- *Maximum and minimum fault levels are sourced from the published 2020 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.*

- *The synchronous generation is represented by its sub-transient impedance values.*

6.0 Technical Requirements

Key functional requirements of the VCNSS is to:

a. Regulate and control the both positive and negative phase sequence voltages at the 66kV bus at Charleville 66/22/11kV substation, to the required setpoints, under normal steady state and contingency conditions.
b. Provide dynamic, fast reactive power response following system contingencies (e.g. network short circuits, line and generator disconnections);
c. Enhance system voltage stability during frequency and / or voltage disturbance events.

6.1 Fundamental Requirements

The VCNSS provider must ensure that their services and equipment satisfy fundamental requirements below. Any departures, exceptions and alternative solutions must be clearly stated in their offer documents. The VCNSS shall:

a. Be simple and practical, be available at any time of day or night and have the capability to vary reactive power output continuously to control voltages at the 66kV bus at Charleville 66/22/11kV substation within the Specific Performance Levels.
b. Provide all equipment and services required to connect to the connection point e.g. substation switchgear, cables, protection upgrades and construction costs.
c. Provide suitable levels of redundancy within its design to meet the Specific Performance Levels.
d. Be able to continuously exchange critical information with Ergon Energy Network Operations Centre (NOC) as per Ergon Energy Standard for Intelligent Electronic Devices (IED) STNW3383. This information includes, but is not limited to alarms, events, monitoring, measurement, control, protection signals and setpoints of reactive power and voltages.
e. Regulate (i.e. generate or absorb) reactive power continuously at the points of connection to:

    i. Improve voltage stability during and post network contingency events,
    ii. Mitigate low and high voltage issues on the network,
    iii. Control positive and negative phase sequence voltages according to Ergon Energy's operational setpoints.

f. Comply with the Ergon Energy Major Customer Connection process which aligns with Chapter 5.3A of the National Electricity Rules (NER).
g. Comply with any relevant performance requirements and financial obligations, fees and charges of an ultimate connection agreement with Ergon Energy and relevant requirements under the NER.
h. Include appropriate AC and DC supplies to achieve the Specific Performance Levels.
i. Have high availability and reliability and must be robust in its operation during system disturbances as required under the Specific Performance Levels.
j. Have the short-term overload capability to meet the Specific Performance Levels.
k. Be individually single phase controlled in such a manner to reduce the NPS voltages at the connection points within relevant dead band parameters set by Ergon Energy system operator. The VCNSS shall balance Negative Phase Sequence (NPS) up to the Specific Performance Levels in Table 6.4 (which aligns with NER S5.1a.7 requirements) with the aim to ensure that NPS should not, under normal system conditions (i.e. no contingency), exceed:

    i. 2.5% more than once per hour, when averaged over any 1-minute period,
    ii. 2.0% when averaged over any 10-minute period, or
    iii. 1.3% when averaged over any 30-minute period

These limits apply for normal and credible single contingency conditions on the Ergon Energy system. Large voltage unbalances, over 2.5%, may occur for short intervals up to one minute due to faults, switching operations or transformer energisation

l. Comply with allocated harmonic emission limits as per AS6100.3.6:2012 (allocation to be provided by Ergon Energy).
m. Have a predictable response at the connection point for any internal plant or communication failures such that appropriate actions such as the VCNSS shutdown or control system response blocked for an appropriate period
n. Have well-designed emergency shutdown procedures such that, whenever possible, the VCNSS shall shutdown in a controlled manner to reduce impacts on the power system. When and where it is safe to do so, the VCNSS shall follow the normal automatic shutdown sequence. However, the VCNSS must also act promptly to protect itself from damages due to faulty equipment and/or dangerous system conditions if deemed necessary.
o. Suppliers shall provide a detailed description of start-up and shut-down sequences including flow diagrams and an indication of times required in each stage. The start-up and shut-down sequences shall minimise the reactive step during switch on and switch off of the VCNSS, except when the unit has tripped by protection systems.
p. The Start-up control sequence shall:
    i. Be fully automatic following the start-up signal which may be locally or remotely applied,
    ii. Indicate ready to start or if not ready, list all reasons why a start is inhibited,
    iii. Set the voltage regulator to the level existing immediately prior to sending a circuit-breaker close allowed signal,
    iv. Indicate locally and at the remote operator’s location when the unit is fully regulating and ready to receive voltage set point instructions from the operator.

q. The Shut-down control sequence shall:
    i. Be fully automatic following the shut-down signal which may be locally or remotely applied,
    ii. Gradually adjust the VCNSS output to zero Mvar at an adjustable rate in order to mitigate voltage fluctuations,
    iii. Indicate locally and at the remote operator’s location that the unit is fully shutdown and offline.
r. Suggest installing a comprehensive recording and monitoring systems, e.g. Power Quality Meter (PQM), High Speed Monitoring Meter (HSM), and PMU (Synchrophasor Measurement Unit), to monitor the VCNSS performance at the connection point for ongoing compliance. Ergon Energy will have similar devices on the network side of the connection point to monitor compliance.
s. Have an environmental and cultural heritage management plan and comply fully with the local rules and regulations

6.2 Ride-through Capability

The VCNSS shall remain in service, fully function up to the Specific Performance Levels, to support the network under all, but not limited to, scenarios below:

a. Energisation of local and remote network elements, e.g. lines, cables, transformers, reactors / inductors, and capacitors. For example, after a circuit breaker reclose event at Roma, Volt-var support by VCNSS must be promptly provided, up to the specified levels, to maintain stable voltages at Charleville substation.
b. Frequency disturbances in the network due to tripping of lines and / or generators (synchronous and asynchronous), control actions of generating plant and any interactions of power electronic controllers with the power system.
c. The VCNSS is expected to balance NPS up to the Specific Performance Levels if the NPS at the connection points is higher than the Specific Performance Levels.
d. Voltage dips, sags, swell, notching, harmonic distortion, lighting and switching transients in the network. The VCNSS is expected perform up to the Specific Performance Levels to minimise the impacts of these events to the network.
e. Voltage fluctuation, harmonic voltage distortion and voltage unbalance conditions at the 66kV bus at Charleville 66/22/11kV substation within the levels specified in clauses S5.1a.5, S5.1a.6 and S5.1a.7 of the NER.

6.3 Availability, Reliability and Robustness

The VCNSS shall:

a. Have an average annual availability (including planned and unplanned outages) of not less than the Specific Performance Levels (6.4.8) and a high reliability, where the mean time between Unscheduled Services must be better than the Specific Performance Levels (6.4.10).
b. The VCNSS shall operate in a robust manner and must remain in stable operation throughout system events where system voltage and frequency excursions may temporarily exceed expected normal operating conditions. The VCNSS must be capable of providing uninterrupted operation during and following power system voltage, frequency, and voltage / current waveform disturbances some of which may occur simultaneously as defined under clause 6.4.13 of the Specific Performance Levels.

6.4 VCNSS Specific Performance Levels

Table 6.4.4 lists the Specific Performance Levels required for the VCNSS. 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 Connection of Embedded Generating Systems to a Distributor's HV Network) as well as the VCNSS Specific Performance Levels.

Item	Description	Rating
6.4.1	Likely frequency for which the VCNSS is expected to be dispatched	Continuously 24 Hours x 365 Days / Year

6.4.2	Maximum time taken to become fully available to provide the service following a 66kV circuit breaker reclose event at Roma	0 hours (must remain operational following a reclose event and ride through other dips or transients)
6.4.3	Minimum level of continuous reactive power compensation available at Charleville substation	±10Mvar Continuous at 66kV, or ±5Mvar Continuous on the 11kV bus and ±5Mvar Continuous on the 22kV bus
6.4.4	Capability for system to be easily expanded in the future if required	Expandable to ± 15Mvar after year 2024
6.4.5	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)
6.4.6	Be capable, on receipt of appropriate input signals, of changing its output from fully inductive e.g. -10Mvar to fully capacitive e.g. +10Mvar	≤ 40 milliseconds
6.4.7	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
6.4.8	Black-start capability	System must be able to provide reactive power support during re-energisation of the 66kV line from Roma
6.4.9	Capability of reactive power range at connection point - 1.0 pu voltage, frequency 49.75 to 50.25 Hz	
	a. Inductive, Continuous	-10Mvar
	b. Capacitive, Continuous	+10Mvar
6.4.10	Average Annual Availability (*) $\% \text{ Availability} = \frac{\text{Total Time VCNSS is able to Perform Specific Performance Levels}}{\text{Total Time Period}}$	99.81% (8743 Hrs / Yr)
6.4.11	Maximum percentage Downtime (**) $\% \text{Downtime} = \frac{\text{Total Downtime}}{\text{Total Time Period}} \times 100$ also, $\% \text{Downtime} = 100 - \% \text{Availability}$	0.19% (17 Hrs / Yr)
6.4.12	Maximum number of downtime events per year	1 per year
6.4.13	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
6.4.14	Measurement accuracy for voltage transformers	Class 0.5M

6.4.15	VCNSS 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
6.4.16	The VCNSS is 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
	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 ± 2.5Hz)	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 auto reclose	
	i. Dead time	5 – 15 sec
	ii. Reclaim time	20 sec
6.4.17	Maximum allowable reactive power step	0.03 pu
6.4.18	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
6.4.19	Maximum equipment design fault currents	
	a. 66kV	25kA rms for 3 sec
	b. 22kV	25kA rms for 3 sec
	c. 11kV	25kA rms for 3 sec
6.4.20	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%
6.4.21	Power System Monitoring	

	a. Power Quality Measurement System	Relevant IEC Standards Up to 100th 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
6.4.22	Maximum allowable sound pressure levels at one metre outside VCNSS perimeter fence	55 dBA
6.4.23	Maximum Radio Interference Voltage outside of the VCNSS perimeter fence.	500 μV
6.4.24	Maximum Allowable Electric Field	
	a. Occupational for the whole working day	10 kV/m
6.4.25	Maximum Allowable Magnetic Field	
	a. Occupational for the whole working day	10,000 milliGauss

Table 6.4 - Volt-var Control Network Support Services (VCNSS) – Specific Performance Levels

Explanatory Notes

(*) VCNSS Availability 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.

7.0 Testing Requirements

The VCNSS Providers must have a proven standard Inspection and Test Plan (ITP) and records of previous test results to demonstrate their capability to meet the specific Testing Requirements. The ITP shall include the following fields that are relevant for each test items listed in the Testing Schedules under Section 10 of this document .

- Test parameters.
- Method of testing – The manner in which the test was carried out (including a copy of the test procedure);
- Response times including simulated outputs with trip signals disabled, if applicable.
- Test schedules – Initial and Subsequent tests.

The previous test results of the VCNSS shall at least include relevant reports of Type Tests, Factory Acceptance Tests (FAT) and Site Acceptance Tests (SAT).

8.0 Information to be Provided by Respondents

The information to be provided by Respondents to a Request for Proposal include, without limitation:

a. Completed Technical Schedule under part 10 of this document

b. Registration status of the Respondent, or proposal to register, under Chapter 2 of the NER;

c. Relevant experience of the Respondent in relation to the provision of the VCNSS, e.g. a Memorandum of Understanding (MoU) of a connection agreement between the Respondent and the relevant Network Service Provider allowing for the delivery of the VCNSS;

d. A description of the equipment to be used to provide the VCNSS and its capabilities;

e. Configuration, concept footprint layout and electrical single line diagram with sufficient rating information of the VCNSS;

f. Complete PSCAD and PSSE models, ratings and parameters of the VCNSS and its control systems for Energy Queensland to facilitate assessment of the network and network participant impacts of the use of the relevant VCNSS. These models (irrespective of registration status) must conform to the AEMO Power System Model Guidelines. Model accuracy staging will at minimum require an initial model and a final validated (post commissioning model). This is sometimes referred to as an R1 and R2 validated model;

g. Relevant documentation as agreed with Ergon Energy to demonstrates VCNSS is able to provide both Volt-var control and NPS balance as set out under the Technical Requirement section. This includes applicable Volt-var and NPS regulator block diagrams for evaluation purposes.

h. Relevant documentation as agreed with Ergon Energy that demonstrate the technical capability, performance and response (i.e. QV) of the VCNSS before, during and after a network fault event;

i. Relevant previous test records demonstrating the capability of the system and equipment to provide the VCNSS;

j. Relevant maintenance records and planned maintenance for VCNSS system and equipment;

k. Information on overload capability and control modes e.g. voltage or reactive power control modes;

l. Relevant technical information of equipment, subsystems and systems used in the VCNSS:

   a. Primary plant;
   b. Secondary systems – monitoring, control, protection and SCADA equipment and systems;
   c. Auxiliary equipment and systems.

m. Information of VCNSS's overvoltage and undervoltage schemes (both control and protection) and associated settings;

n. Relevant information on cyber security safeguard practices and applicable cyber security frameworks for the VCNSS;

o. Information of the VCNSS's harmonic and interharmonic emissions up to the 100th order over the full operating range, e.g. from -10 Mvars to +10 Mvars, including single phase control limits;

p. A list of technical departures and alternative proposals for the specified requirements that the VCNSS providers cannot meet. A full explanation must also be supplied together with any alternative proposals;

q. Relevant information of the Power System Monitoring Equipment as per the specific performance levels 6.4.18;

r. Information of the start-up, controlled shut-down and emergency shut-down sequences;

s. Details of the proposed VCNSS self-diagnosis capability as per clause 6.1.m of the fundamental requirements;

t. Reliability, Availability and Maintainability (RAM) calculation of the proposed VCNSS;

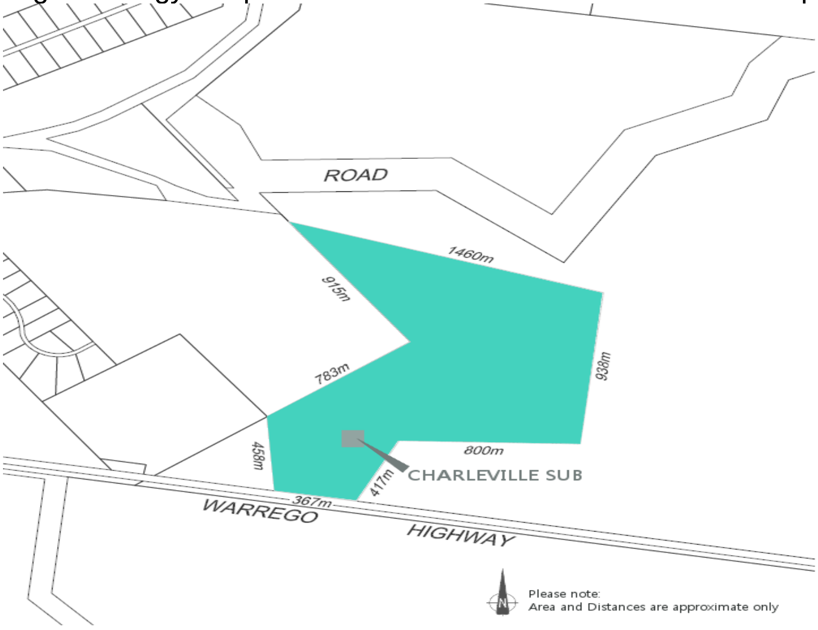
u. The loss assessment of the proposed VCNSS for evaluation purposes;

v. VCNSS's control and protection Systems reports, including typical operational settings of the open loop and close loop control system strategies to efficiently control Volt-vars at the connection points.

w. A table of all VCNSS protection trips (whether triggered internally or externally to the VCNSS) and shall indicate which trips are to be controlled in a step-less manner, and which are to be instantaneous.

9.0 Negotiable Services and Facilities

Ergon Energy owns a parcel of land surrounding the Charleville zone substation (as indicated below). Ergon Energy is open to discussions around the use of this parcel of land as part of the VCNSS.



10.0 Technical Schedules for RFP Evaluation

10.1 Technical Schedule A - Specific Performance Levels

Item	Description	Compliance / Departures / Alternative Offers
10.1.1	Likely frequency for which the VCNSS is expected to be dispatched	
10.1.2	Maximum time taken to become fully available to provide the service following a 66kV circuit breaker reclose event at Roma	
10.1.3	Minimum level of continuous reactive power compensation available at Charleville substation	
10.1.4	Capability for system to be easily expanded in the future if required	
10.1.5	Redundancy of system design	
10.1.6	Be capable, on receipt of appropriate input signals, of changing its output from fully inductive e.g. -10Mvar to fully capacitive e.g. +10Mvar	

10.1.7	Capability of continuous uninterrupted operation during and following a system voltage disturbance e.g. a load reduction event	
10.1.8	Black-start capability	
10.1.9	Capability of reactive power range at connection point - 1.0 pu voltage, frequency 49.75 to 50.25 Hz	
	a. Inductive, Continuous	
	b. Capacitive, Continuous	
10.1.10	Average Annual Availability (*) $\% \text{ Availability} = \frac{\text{Total Time VCNSS is able to Perform Specific Performance Levels}}{\text{Total Time Period}}$	
10.1.11	Maximum percentage Downtime (**) $\% \text{Downtime} = \frac{\text{Total Downtime}}{\text{Total Time Period}} \times 100$ also, $\% \text{Downtime} = 100 - \% \text{Availability}$	
10.1.12	Maximum number of downtime events per year	
10.1.13	System voltage at point of connection	
	a. Nominal system voltage	
	b. Voltage range for continuous operation	
10.1.14	Measurement accuracy for voltage transformers	
10.1.15	VCNSS Allowable Droop Settings	
	a. Boost	
	b. Buck	
	c. Voltage Dead band	
10.1.16	The VCNSS is 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)	
	b. Minimum temporary voltage (30 sec)	
	c. Long term over voltage (1800s)	
	d. Short term over voltage (0.2s)	
	e. A drop in one or more phases of the voltage at the point of connection	
	f. Voltage oscillating (at a frequency of ± 0.25 to ± 2.5Hz)	
	g. Worst asymmetrical faults to be expected at 66 kV bus	
	h. Worst asymmetrical faults to be expected at 22 kV bus	
	i. Worst asymmetrical faults to be expected at 11 kV bus	
	j. A switching surge of 2.2 pu at the connection point	
	k. A fall in system frequency to 46.5 Hz, with recovery to 46.5 – 52.5 Hz	

	I. High speed auto reclose	
	iii. Dead time	
	iv. Reclaim time	
10.1.17	Maximum allowable reactive power step	
10.1.18	System frequency at point of connection	
	a. Nominal frequency	
	b. Normal control range	
	c. Transient excursions (less than 1 minute)	
	d. Transient excursions (less than 2 minutes)	
10.1.19	Maximum equipment design fault currents	
	a. 66kV	
	b. 22kV	
	c. 11kV	
10.1.20	Negative Phase Sequence Control	
	a. Minimum reactive power required, per phase, for individual phase control.	
	b. Typical dead band setting	
	c. Deadband setting range	
10.1.21	Power System Monitoring	
	a. Power Quality Measurement System	
	b. High Speed Fault Recorder System (multi-channels)	
	c. Synchrophasor Measurement Units (PMU)	
10.1.22	Maximum allowable sound pressure levels at one metre outside VCNSS perimeter fence	
10.1.23	Maximum Radio Interference Voltage outside of the VCNSS safety fence.	
10.1.24	Maximum Allowable Electric Field	
	a. Occupational for the whole working day	
10.1.25	Maximum Allowable Magnetic Field	
	a. Occupational for the whole working day	

Table 10.1 - TECHNICAL SCHEDULES A – VCNSS Specific performance Levels

10.2 Technical Schedule B - Specific Testing Requirements

Test Items	Test Parameters	Test Methods and assumptions	Recommended Initial and Subsequent Tests
10.2.1	Generation of reactive power		
10.2.2	Absorption of reactive power		
10.2.3	Response times including simulated outputs with trip signals disabled where applicable		
10.2.4	Automatic gain adjustment when voltage instability is detected		
10.2.5	Automatic (PPS) Voltage Regulation		
10.2.6	Automatic Reactive Power Regulation		
10.2.7	Automatic NPS balance		

10.2.8	Ride-through capability as per specified conditions		
10.2.9	Equipment and Transducer calibration tests		
10.2.10	Measurement accuracy tests		
10.2.11	Control system tests		
10.2.12	Protection system tests		
10.2.13	Data and communication network tests		
10.2.14	Voltage step tests		
10.2.15	Voltage Stability tests		
10.2.16	Sustained abnormal voltage tests – high and low voltages		
10.2.17	Sustained reactive power tests – generate and absorb reactive power at specified limits.		
10.2.18	Harmonic Compliance Tests		
10.2.19	NPS balance Tests		
10.2.20	EMC tests		

Table 10.2 - TECHNICAL SCHEDULES B – VCNSS Specific testing requirements

11.0 Connection Assets

The VCNSS provider will need to arrange with Ergon Energy's Customer Connection team for the establishment of suitable connection assets for connection of the VCNSS equipment. These connection costs depend on the system voltage, nominal current, location from existing infrastructure and other aspects defined in the NER such as system strength remediation. Proponents **are asked to exclude these costs in the initial RFP.**

Shortlisted proponents will be required prior to submission of their final offer to give an indication of likely connection costs for their proposal.(Table 4.1 - *Stage 5)*

12.0 Net Present Value

The NER requires the Final Project Assessment Report to include the preferred option under the RIT-D. This was included in the FPAR "Charleville 66 kV Voltage Management" published 22 May 2019. This should be the option which is expected to maximise the present value of the net economic benefits to all those who produce, consume and transport electricity in the NEM.

Net Present Values of the four credible options are presented in Table 12.1 below. This comparison demonstrates that Option C has the greatest Net Present Value.

Cost	Item	Option A: 10Mvar STATCOM - Internal Option	Option B: Network Support Arrangement (10Mvar STATCOM without optional 2.8MW of embedded generation)	Option B: Network Support Arrangement (10Mvar STATCOM including optional 2.8MW of embedded generation)	Option C: Network Support Arrangement (10MW solar farm, battery storage and optional STATCOM)
Project Costs	Capital Costs	$ 10,749,647	$ 5,630,092	$ 5,630,092	$ 3,982,421
	Network Support	$ -	$ 20,496,716	$ 25,696,716	$ 5,503,615
	Maintenance / Operation	$ 888,526	$ -	$ -	$ -
	Total costs (incl. overheads)	$ 11,638,173	$ 26,126,808	$ 31,326,808	$ 9,486,036
Market Benefits	Changes in electrical energy losses	$ -	$ -	$ -	-$ 1,091,083
	Total Market Benefit	$ -	$ -	$ -	-$ 1,091,083
	Benefit Less Costs	-$ 11,638,173	-$ 26,126,808	-$ 31,326,808	-$ 10,577,119
	Ranking	*2*	*3*	*4*	*1*

Table 12.1 Charleville FPAR Net Present Value Analysis

The total cost of Option C, inclusive of operating costs and a market benefit of negative $1.09M (due to increased network losses), was estimated at approximately $10.58M in present value terms. This was lower than the estimated costs of Option A ($11.64M) and Option B ($31.37M with generation and $26.13M without).

For the purpose of this analysis, Ergon Energy considers that this is the maximum cost of an option involving a Network Support Agreement. This shows that a Network Support Agreement solution maximises the present value of net economic benefits under all reasonable scenarios considered within the RIT-D. The estimated cost of Option C assumes that each of the components identified in the submission to Ergon Energy would be built. It is possible that a Network Support Agreement, capable of meeting the identified need, could be implemented in sufficient time with a different combination of assets and potentially a lower cost (and therefore a greater net benefit).

In either case, a Network Support Agreement has been identified as the option resulting in the greatest net benefit if it is at a negotiated rate that represents the lowest NPV.

The preferred option is therefore: Option C: Network Support Agreement by the provision of reactive power via an external provider - External Submission Provider. It is noted that Option B is also based on the proponent owning and operating equipment to provide reactive power via a Network Support Agreement and is also a valid option. Option C is the preferred option due to its lower costs.

13.0 Submissions from Solution Providers

Ergon Energy invites written submissions to address the identified need in this report from registered participants and interested parties. Ergon Energy will not be legally bound in any way or otherwise obligated to any person who may receive this RFP 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 RFP, any site visits, obtainment of further information from Ergon Energy or the preparation by a proponent of a proposal to address the identified need specified in this RFP. The RFP is aimed at identifying a technically feasible non-network alternative to the internal option that has greater net economic benefits. However, the selection of the solution provider to implement the preferred option will be done after the conclusion of the RFP and in accordance with Ergon Energy standards for procurement. Submissions in writing are due by 4 pm December 17, 2021 and should be lodged to demandmanagement@ergon.com.au

14.0 Next Steps

At the conclusion of the consultation process, Ergon Energy intends to take steps to progress the recommended solution(s) to ensure any statutory non-compliance is addressed and undertake appropriately justified network reliability improvement(s), as necessary. Please note that at the conclusion of the RFP, for Ergon Energy to act on a submission from a non-network proponent, Ergon Energy need to enter into a legally binding contract with that non-network proponent for delivery of the non-network solution within a timeframe satisfactory to Ergon Energy to ensure timely completion of the project.

15.0 Risk

In the event that during the RFP process there is a catastrophic failure of the SVC at Charleville Ergon may revert to a Network solution or need to consider compressed time frames for this RFP.

16.0 References

1. Regulatory Investment Test for Distribution – Final Project Assessment Report – “Charleville 66kV Voltage Management”, Ergon Energy, 22nd May 2019.
2. Prequalification of Providers for Network Support and Services – Obligatory Reactive Power Support Charleville 66/22/11kV Substation, Ergon Energy.
3. Request for Expressions of Interest Non-Market Network Support Services – Dynamic Reactive Power Support, AEMO.
4. Non-Market Network Support Services, AEMO.
5. Network Support and Control Ancillary Service (NSCAS) Description, AEMO.
6. Network Support and Control Ancillary Service (NSCAS) Quantity Procedure, AEMO.
7. Australian Standard AS 60038 – 2012, Standard Voltages, Standards Australia 2012.