Technical Standard - TS134

Communication Systems (inc. SCADA) for Embedded Generation

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SA Power Networks

Empowering South Australia

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1. Introduction

This technical standard specifies to designers, contractors, and consultants the technical requirements for the communication systems, including SCADA, for embedded generation (EG) systems that are connected to SA Power Networks' distribution network.

Technical Standards TS132 - *Low Voltage EG Connections above 30kVA* and TS133 – *High Voltage Embedded Generation Connection Technical Requirements* specify the type of communication system required.

2. Definitions and Abbreviations

2.1 Definitions

Connection Point	As per Electricity (General) Regulations 2012: A connection point to a transmission or distribution network. For this document, connection point also has the same meaning as point of supply as defined in AS/NZS 3000. The point of supply established between SA Power Networks and the customer.
Customer	A person who engages in the activity of purchasing electricity supplied through the distribution network to a connection point and is registered by AEMO as a customer under chapter 2 of the NER.
Distributed Energy Resources	Power generation or energy storage units that are connected directly to the distribution network.
Distribution Network	References to distribution network means the network poles, wires, underground cables, transformers, substations, etc, operated by SA Power Networks, which transports electricity to and from a customer's connection point.
Electricity Distribution Code	The Electricity Distribution Code made by ESCOSA pursuant to Section 28 of the Essential Services Commission Act 2002.
Embedded Generating Unit	A generating unit connected within a distribution network and not having direct access to a transmission network.
Embedded Generator	A generator (ie customer), who owns, operates, or controls an embedded generating unit.
Energy Storage Unit	Plant that is able to both, store electricity from, and discharge electricity to, units within the same generating system and/or distribution network (ie act as both a load and a generating unit)
Energy Storage System	A system comprising one or more energy storage units
Extra Low Voltage	Voltage not exceeding 50V ac or 120V ripple-free dc
Generating System	All embedded generating units and the associated control and protection equipment that is located on the customer's side of the connection point.
Generating Unit	The actual generator of electricity and all related equipment essential to its function as a single entity.

Generation Despatch Limit	A real power output limit value sent via a SCADA signal by the DNSP to be applied at the individual generating unit terminals.
Generator	A person/entity who engages in the activity of owning, controlling, or operating a generating system that supplies electricity to, or who otherwise supplies electricity to, a transmission or distribution network.
Grid	Portion of the electrical distribution system that is operated by an electrical distributor. Note: An alternative term for grid is electricity distribution network.
Grid Isolation Device	A device designed to safely break voltage and current such as a circuit breaker or contactor on the customer side of the connection point.
High Voltage	Voltage exceeding low voltage
Inter-trip	An anti-islanding protection scheme that is operated by the distribution network service provider to disconnect the embedded generating system when a network fault occurs.
Inverter	The device that may form part of the generating system which uses semiconductor / power electronics devices to convert direct current to alternating current.
Inverter Energy System	A system consisting of one or more inverters that operate by converting direct current to alternating current. In the context of system capacity, this definition includes the capacity of ac coupled energy storage systems.
Large Embedded Generation	IES and non-IES EG installations with a combined nameplate rating greater than 200 kVA
Low Voltage	Voltage exceeding 50V ac or 120V ripple free dc and not exceeding 1,000V ac or 1,500V dc
Medium Embedded Generation	IES and non-IES EG installations with a combined nameplate rating greater than 30kVA and no more than 200kVA
Nameplate Rating	The maximum continuous output or consumption in MW of an item of equipment as specified by the manufacturer, or as subsequently modified. Where the rating of an item of plant is specified by the manufacturer in MVA and not MW, the nameplate rating is determined by converting the manufacturer's rating in MVA to the rating in MW by applying a conversion factor of 1.
National Electricity Rules	The rules as defined in the National Electricity Law as set out in the Schedule to the National Electricity Act 1996 (SA).
Small Embedded Generation	A single phase or three phase inverter connected embedded generation system up to 30kVA.
System Capacity	Nameplate ratings of the inverter energy system or non-inverter energy systems, measured in VA

Supply	The delivery of electricity.
Total System Capacity	Sum of the nameplate ratings of the inverter energy systems or non-inverter energy systems comprising the embedded generation connection, measured in VA
Transmission Network	Network operated by ElectraNet.

2.2 Abbreviations

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator Limited (ACN 072 010 327)
AER	Australian Energy Regulator
AS/NZS	A jointly developed Australian and New Zealand Standard
AS	Australian Standard
BESS	Battery Energy Storage System
CBD	Central Business District
CT	Current Transformer
EDC	Electricity Distribution Code
EG	Embedded Generation or Embedded Generating
ELV	Extra Low Voltage
EMTC	Electricity Metering Code (ESCOSA)
ESCOSA	Essential Services Commission of South Australia
ESS	Energy Storage System
GDL	Generation Dispatch Limit
HV	High Voltage
IEC	International Electrotechnical Commission
IES	Inverter Energy System
LEG	Large Embedded Generation
LV	Low Voltage
MEG	Medium Embedded Generation
MMOF	Multimode Optic Fibre
NEL	Net Export Limiter
NER	National Electricity Rules
NEM	National Electricity Market
NMI	National Meter Identifier

NOC	SA Power Networks' Network Operations Centre
PLC	Programmable Logic Controller
PV	Photovoltaic
RTU	Remote Telemetry Unit (Also known as 'Remote Terminal Unit' or 'Remote Telecontrol Unit')
SCADA	Supervisory Control and Data Acquisition
SIR	Service & Installation Rules
VT	Voltage Transformer

2.3 Terminology

may	Indicates a requirement that is not mandatory but can be imposed on the customer as deemed appropriate by SA Power Networks.
must	Indicates a mandatory requirement.
shall	Indicates a mandatory requirement.
should	Indicates a recommendation that will not be mandatory but can be imposed on the customer as deemed appropriate by SA Power Networks.
Suitable (or Suitably):	To the satisfaction of the relevant SA Power Networks Manager.

3. Relevant Rules, Regulations, Standards and Codes

3.1 Standards and Codes

The following listed documents are for additional information and other documentation may be required on a project specific basis. Please note: It is the responsibility of the customer to ensure you have complied with all applicable, SA Legislative Regulations (under Acts), ESCOSA/ENA/AEMC/IEC documentations, relevant AS/NZS standards, the SA Power Networks publications, and you have ensured their current publications, before implementing them.

Standards Australia Publications:

AS 2067	2016	Substations and high voltage installations exceeding 1 kV ac
AS/NZS 3000	2018	Electrical Installations (known as the wiring rules)
AS/NZS 3010	2017	Electrical Installations - Generating sets
AS/NZS 3017	2007	Electrical installations - Testing User Guides
AS/NZS 3100	2017	Approval and test specification - General requirements for electrical equipment
AS/NZS 4777.1	2016	Grid connection of energy systems via inverters - Installation requirements
AS/NZS 4777.2	2020	Grid connection of energy systems via inverters - Inverter requirements
AS 60529	2004	Degrees of Protection Provided by Enclosures (IP Code)

IEC

IEC 60255-12	1980	Electrical Relays – Directional relays and power relays with two input energizing quantities
IEC 60255-26	2013	Electrical relays – Part 26: Electromagnetic compatibility requirements
IEC 60255-27	2013	Measuring relays and protection equipment – Part 27: Product safety requirements
IEC 60255-127	2010	Measuring relays and protection equipment – Part 127: Functional requirements for over/under voltage protection

IEEE

IEEE 802.3	2018	IEEE Standard for Ethernet

SA Power Networks Documents:

- Manual 32: Service & Installation Rules
- Technical Standards & NICC Brochures, in particular:
  - TS085: Trenching and Installation of Underground Conduits and Cables (up to and including 33kV)
  - TS 132: Low Voltage EG Connection Technical Requirements – Capacity above 30kVA
  - TS 133: High Voltage Embedded Generation Connection Technical Requirements

3.2 Legislation and Regulations

This section provides a list of the relevant legislation and regulations which shall apply to the design, manufacture, installation, testing and commissioning, and operations and maintenance of all plant and equipment for HV EG connections to the distribution network.

In an event where there is any inconsistency between legislation and regulations and these technical requirements, the legislation and regulations shall prevail.

- Electricity Act 1996 (SA)
- Electricity (General) Regulations 2012
- National Electricity Rules (NER)
- Electricity Distribution Code (ESCOSA)
- Work Health and Safety Act 2012
- Work Health and Safety Regulations 2012

4. General Requirements

Remote monitoring and control will be required in cases where the combined generation capacity represents a significant portion of the total area load (typically export of 200kW or more), or a credible network constraint has been identified or where deemed necessary by SA Power Networks. The requirements will be determined during SA Power Networks' assessment of the proposed EG system's connection to the distribution network and will be provided in the Engineering Report.

Prior to final site commissioning the control system will need to be made available to SA Power Networks for user acceptance testing (UAT).

5. SCADA Requirements

The nameplate rating and operational requirements of the proposed EG system in relation to the capacity of the distribution network at the proposed connection point will influence the actual interface and communications requirements**.** Table 1 summarises the type of remote monitoring and control applicable to various types of generating systems. SA Power Networks defines two SCADA profiles, SCADA (simplified) and SCADA (Inter-trip). The requirements of these profiles are shown in clause 5.1.

For generating systems with multiple connection points, export requirements are considered for each individual NMI at the connection point.

Table 1: Remote Monitoring & Control requirements by Generation type and Capacity

Generation Type	Non-Export		Export		
	<5MVA	≥5MVA	≤200kVA	>200kVA, <5MVA	≥5MVA
IES[1]	Not Required	SCADA (Simplified)	Not Required	SCADA (Simplified)	SCADA (Inter-trip)
Non-IES	SCADA (Simplified)[2]	SCADA (Simplified)	SCADA (Inter-trip)	SCADA (Inter-trip)	SCADA (Inter-trip)

Notes:

1. IES not compliant to AS/NZS 4777.2 shall comply to non-IES requirements
2. Only required where fault levels require management or fault ratings are at risk of exceedance (eg CBD 11kV)

5.1 Remote Monitoring and Control Arrangements

The customer shall be responsible for providing all SCADA and protection inputs (as applicable) to SA Power Networks at the designated interface points. This may include the following equipment:

- protection relays (eg aux trip relays, directional distance relays, differential protection relays);
- current and voltage transformers;
- SCADA RTU;
- DC power system;
- discrete digital signalling fibre or radio system (eg tele-protection scheme; multiplexing or switch/router);
- private or public mobile carrier network equipment; and
- SA Power Networks' communications cubicle or cabinet.

5.1.1 SCADA (Simplified)

Table 1 outlines what generating systems require SCADA (simplified). Figure 1 shows the typical SCADA block diagram for these systems.

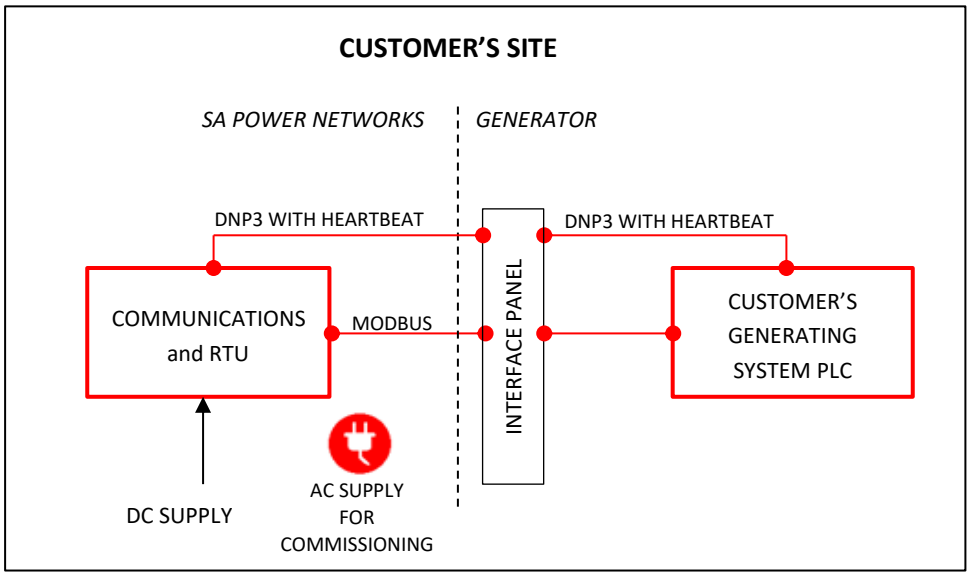

Figure 1: Block diagram of SCADA/Tel solution for generating systems without inter-trip

To facilitate connection of the SCADA (simplified) equipment, the following requirements must be met by the customer:

5.1.1.1 Accommodation for SA Power Networks' Equipment

1. The customer shall provide a suitable wall space or 75mm × 75mm square steel post (typical) as close as practical to the customer's metering position, or in an easily accessible location, for the installation of a lockable SCADA enclosure with unobstructed access by SA Power Networks personnel. This location must be within normal copper serial communication cable length (15m) from the site controller.
2. SA Power Networks shall provide the lockable SCADA stainless steel enclosure (W300mm × H380mm × D210mm, weight 7kg) and the customer shall install the enclosure on the wall or post. SA Power Networks shall commission the SCADA RTU and cellular router.
3. The customer shall provide a 32mmØ conduit to the SA Power Networks SCADA enclosure including provision of a 2.5mm² Cu cable for 24V dc supply and copper RS-232 serial data cable and clearly label the conductor functionality (ie +ve, -ve, TX, RX and GND).

4. The customer shall provide a suitability sized earth bonding for the enclosure back to the customer's common earth bar.

5.1.1.2 Interfaces

1. Provide a serial RS-232 interface standard (compliant V24 and V28). A TCP/IP (IEEE 802.3) interface shall be considered on request.
2. Provide serial Modbus protocol for SCADA interface between customer's generating system PLC and SA Power Networks' RTU.
3. Physical layer delivery shall be via a copper RS-232 serial communication cable however this standard has a distance limitation of notionally 15m. Note the customer and SA Power Networks' equipment cubicles shall be solidly earth bonded under this arrangement.
4. For separation distances of notionally greater than 15m the delivery method shall be via a 'Multi-Mode Optic Fibre' (MMOF) via RS-232 serial communication protocol utilising optical to copper serial media converters.

5.1.1.3 DC Power System

1. Provide 24V dc backup power from the customer's protection and control system to supply the SA Power Networks' SCADA enclosure.
2. The DC system shall have a 24-hour survival time.

5.1.1.4 Circuit Breaker(s) (Disconnecting Generator(s))

The trip circuit to be a normally closed circuit.

5.1.1.5 Communication Signal Fail-safe

The PLC must be capable of receiving a pulse for a healthy communications signal from SA Power Networks' RTU every 60s from which the customer's generating system PLC will initiate an automatic controlled shutdown of the generating system in the event of a communications failure indicated by the lack of any single pulse. Upon loss of communications between SA Power Network's RTU and the customer's control room, an automatic controlled shutdown of the generating system is to be automatically carried out by the customer following a timeout delay of 15–45mins as specified by SA Power Networks.

5.1.1.6 SCADA Input/Output

1. Customer to liaise with SA Power Networks to provide a list of SCADA inputs for the generating system.
2. SCADA data shall be via RS-232 serial Modbus communication protocol (refer "interfaces"). Hard-wired I/O will not be permitted.
3. Prior to beginning SA Power Networks' SCADA works on site, the customer's generating system PLC must be brought into SA Power Networks' offices for 'User Acceptance Testing' (UAT) and confirmation that the PLC communicates correctly with SA Power Networks' equipment.

5.1.1.7 Site Access

24 hours site access to SA Power Networks' equipment for faults and maintenance (escorted or non-escorted).

5.1.2 SCADA (Inter-Trip)

Table 1 outlines what generating systems require SCADA (inter-trip). Figure 2 shows the typical SCADA block diagram for these systems

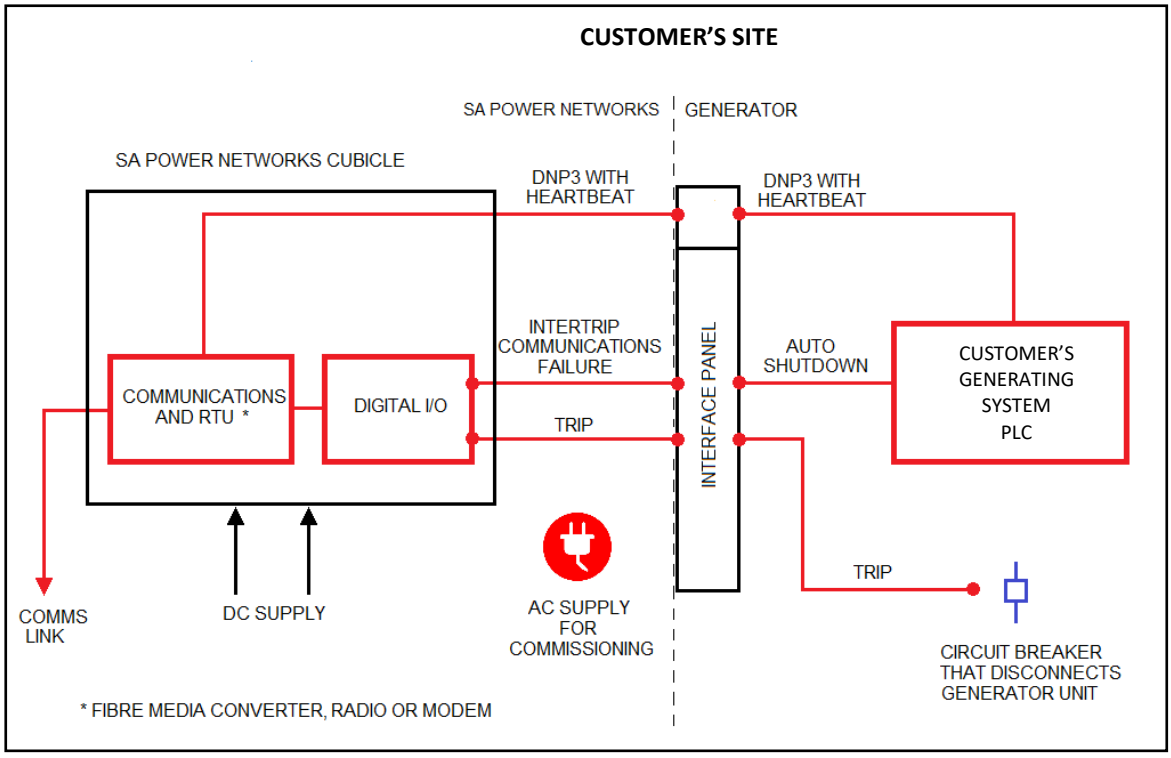

Figure 2: Block diagram of SCADA/Tel solution for generating systems with inter-trip interfaces

To facilitate connection of this size and type of generating system, the following requirements must be met by the customer:

5.1.2.1 Accommodation and Requirements for SA Power Networks' Equipment

1. SA Power Networks' communications cubicle shall be located inside the customer's control room and identify any special environmental consideration (eg IP56 rating (wet areas), dust, hazards, and temperature/climate control). Allow for W800mm × H2,100mm × D600mm floor space for a free-standing equipment cubicle with front and rear access preferred. Front access only shall be considered.
2. SA Power Networks is responsible for providing, installing, and commissioning its equipment.
3. Within the control room the cubicle clearance shall comply with AS/NZS 3000.
4. Provide an earth bonding point for the cubicle connecting to customer's common earth bar.

5.1.2.2 Interfaces

Provide an interface panel as a signal demarcation point within the customer's control room adjacent to the SA Power Networks equipment cubicle.

1. Provide a serial RS-232 interface standard (compliant V24 and V28). A TCP/IP (IEEE 802.3) interface shall be considered on request.
2. Provide serial Modbus protocol for SCADA interface between customer's generating system PLC and SA Power Networks' RTU.

3. Physical layer delivery shall be via a copper RS-232 serial communication cable however this standard has a distance limitation of notionally 15m. Note the customers and SA Power Networks' equipment cubicles shall be solidly earth bonded under this arrangement.
4. For separation distances of notionally greater than 15m the delivery method shall be via a 'Multi-Mode Optic Fibre' (MMOF) via RS-232 serial communication protocol utilising optical to copper serial media converters
5. Fail-safe contact arrangement with SA Power Networks' digital I/O to the demarcation terminal strip. Refer to "Circuit Breaker" section below.

5.1.2.3 DC Power System

1. Provide 24V dc backup power from the customer's protection and control system to supply the SA Power Networks' equipment cubicle SA Power.
2. Provide two individual protected feeds from an appropriately rated ELV circuit breaker to dual isolators located adjacent or above SA Power Networks' equipment cubicle.
3. Each feed to be able to provide 100W of load.
4. The DC system shall have a 24-hour survival time.

5.1.2.4 AC Supply

Provide 230V socket outlet supply for commissioning purposes.

5.1.2.5 Circuit Breaker(s) (Disconnecting Generator(s))

The trip circuit to be a normally closed circuit.

5.1.2.6 Fibre/Radio Connection to Customer's Control Room

1. Allowance for external entry of fibres or coaxial cables into the customer's control room and access to SA Power Networks' cubicle (ie cable ladder). For conduit entry refer to SA Power Networks' technical standard TS085.
2. Allow for installation of external radio mounting structure and antenna should this communications method be utilised.

5.1.2.7 Communication Signalling Fail-safe

From SA Power Networks' RTU located in the SA Power Networks' substation (compulsory requirement), a 60s watchdog pulse arrangement will be in place. The customer's PLC will initiate an automatic controlled shutdown of the generating system in the event that this pulse is not received indicating a communications failure (either via customer's generating system PLC or SA Power Networks' RTU).

5.1.2.8 SCADA Input/Output

1. Customer to liaise with SA Power Networks to provide a list of SCADA inputs/outputs for the generating system.
2. Provide serial Modbus protocol for SCADA interface between customer's generating system PLC and SA Power Networks' RTU.
3. Prior to beginning SA Power Networks' SCADA works on site, the customer's generating system PLC must be brought into SA Power Networks' offices for 'User Acceptance Testing' (UAT) to confirm that the PLC communicates correctly with SA Power Networks' equipment.

5.1.2.9 Control Room Temperature

The customer shall provide a temperature-controlled environment, between+20°C and +30°C (eg. air conditioned), where SA Power Networks equipment shall be located.

5.1.2.10 Site Access

24-hour unrestricted site access to SA Power Networks' equipment for faults and maintenance (escorted or non-escorted – preferably the latter).

5.1.3 Permissive and Demand Availability Signaling

Permissive signaling provides a method for SA Power Networks to indicate those times when a generating system may or may not connect to and operate in parallel with the network. Permissive signaling is required for all generating systems which requires SCADA.

SA Power Networks reserves the right to request the installation of permissive signaling on generating systems if SA Power Networks deems it necessary (eg where fault current limiting methods are employed within the generating system).

The permissive signaling scheme is in addition to other SA Power Networks' EG system protection requirements.

Where a permissive signaling scheme has been deemed necessary, SA Power Networks will, at the customer's expense, install a communication link between the EG system and the relevant SA Power Networks' substation. Alternatively, the customer may provide this communication link according to SA Power Networks' specification. Under some circumstances, depending on the location and connection voltage, SA Power Networks may require diversity or duplication of these communications links.

SA Power Networks will provide the permissive signaling signal to an agreed interface panel installed at an agreed location on the customer's site. On receipt of a 'permission denied' signal it will be the responsibility of the customer to ramp down the generating units before tripping the circuit breakers of all rotating generating units. The permissive signaling signal from the interface panel to the generating unit's circuit breakers, including the communications link, must be of fail-safe design.

The permissive signaling scheme shall be installed such that the EG system performs the requirements shown in **Table 2** whenever a 'permission denied' or 'permission granted' signal is issued by SA Power Networks:

Table 2 : Permission Denied / Granted Operation Requirements

OPERATION	REQUIREMENT
Ramp down	All IES generating units shall ramp down in accordance with the principles of AS/NZS 4777.2; 0MW output must be achieved in 360 seconds. All rotating systems shall ramp down as per ramp rate specified by SA Power Networks in the engineering report, typically 1,000kW per minute.
Disconnection	All rotating generating units shall be disconnected from the Network in 360 seconds.
Permission Granted	All IES generating units shall have 'Soft Ramp Up after Connect or Reconnect Mode' in accordance with the principles of AS/NZS 4777.2

5.1.4 Interface Signals

A detailed list of interface signals will be prepared as the customer's generating system project progresses.

Inverters must be capable of (either directly or from a central controller) receiving and accepting GDL and power factor set points issued by SA Power Networks via its SCADA system. Therefore, if an inverter is certified as being AS/NZS 4777 compliant but does not have an interface enabling the MW and PF limits to be applied in real time, either directly by our SCADA or by an overarching generating system controller, it is unacceptable for connection to SA Power Networks' network.

Typical SCADA data interface requirements for multiple generating units connected via a HV connection point are shown in **Table 3** to **Table 6**.

When there are multiple connection points, the metering and control interface signals and reference signals will be required for each connection point.

The types of interface signals are described below:

5.1.4.1 Generation Dispatch Limit (GDL)

A GDL control system must be provided to control the proposed generating system's real power output. The GDL control system required by SA Power Networks will consist of a control signal that will be initiated manually via SA Power Networks' NOC and transmitted to the generating system via the SCADA Control.

The GDL will provide an analogue signal providing the set point, which will normally be set at the rated capacity of the network connection. However, subject to network conditions, the GDL set point may be altered to constrain the generating system's output between 0MW and the rated capacity of the generation system to suit the network or AEMO dispatch requirements.

5.1.4.2 Net Export Limit

The net export limit control system will be provided to enable SA Power Networks to control the export at the connection point of the proposed generating system's real power output. The next export limiter will consist of a control signal that will be initiated manually via SA Power Networks' NOC and transmitted to the generating system via the SCADA control to constrain the net site export at the connection point to suit the network requirements (eg abnormality on the Network).

5.1.4.3 Power Factor Setpoint

In order to meet network requirements, SA Power Networks may vary the generating system's power factor set point at the connection point, taking into consideration the technical and reasonable limitations of the inverter. The required power factor will be applied automatically via the power factor set point control.

5.1.4.4 Discharge / Charge Rate Limit

When an energy storage system has the ability to charge from the network, the proposed energy storage system may be subject to limits on the time and/or rate at which it may charge, and a constraint may also be applied on the amount and/or rate of energy discharged back into the network.

5.1.4.5 Frequency Response Import / Export Limit

Generating systems intending to participate in the FCAS market may be subject to export and import limits at the connection point to prevent overload / reverse overload of distribution network limits during delivery of FCAS.

The generating system's control system must be capable of accepting net import / export limits at the connection point from SA Power Networks' NOC via SCADA and ensure the bidding algorithms take these limits into account such that the net power flow at the connection point does not violate the distribution network limits during delivery of FCAS.

5.1.4.6 DC Metering

DC coupled generating systems with multiple sources connected behind the same inverter will be required to provide DC metering for each generation source (e.g. Volts, Amps, and kW) in addition to the total AC generating system and connection point values.

5.1.4.7 Digital Inputs to SA Power Networks

SA Power Networks requires the digital inputs as shown in **Table 3**.

All available AC, DC and communication alarms are required. These signals indicate if the DC Supply bus has failed, the secondary system's battery charger station has failed, if a mains AC fail has been detected, if any SCADA or protection communication have failed, or if permission to connect/denied or inter-trip protection has been received.

Table 3: SCADA Digital Input Requirements (From Generator to SA Power Networks)

Digital Inputs for SCADA (Simplified)	Digital Inputs for SCADA (Inter-trip)	Signal Condition
Permission to Connect Received	Permission to Connect Received	Granted/ Denied
	All available AC and DC alarms[1] Mains AC Failure[1] DC Supply Battery Charger Failure[1] DC Supply Failure[1]	Normal/ Failed Normal/ Failed Normal/ Failed Normal/ Failed
	Generating System Communications Alarms	Normal/ Fault
	Generating System HV Circuit Breaker Status[2]	Open/ Closed
	Generating Unit Status (for all Generating Units)[3]	Running/ Stopped
Frequency response active (If required)		On/ Off

Notes:

1. May be required, to be stipulated in Engineering Report
2. Required for rotating systems, systems >5MVA or as stipulated in Engineering Report
3. Required for rotating systems

5.1.4.8 Digital Outputs from SA Power Networks

In addition to permission to connect/denied as shown in **Table 4**, SA Power Networks will send a Heartbeat which is toggled on/off by SA Power Networks' RTU to indicate active communication with the customer's control system.

Table 4: SCADA Digital Output Requirements (From SA Power Networks to Generator)

Digital Outputs for Simplified SCADA	Digital Outputs for Full SCADA	Signal Condition
Permission to Connect (permissive signalling)	Permission to Connect (permissive signalling)	Granted/ Denied
Demand Available for Energy Storage Systems to charge (if required)	Demand Available for Energy Storage Systems to charge (if required)	Available/Unavailable
Heartbeat to indicate active communication		On/Off

5.1.4.9 Analogue Outputs from SA Power Networks

SA Power Networks will issue analogue output as shown in **Table 5**. The control signals from the customer to SA Power Networks are required to feedback the real-time operation of the generating system in response to these set points.

Table 5: SCADA Analogue Output (from SA Power Networks) Requirements

Analogue Outputs for Simplified SCADA	Analogue Outputs for Full SCADA
Generating System Dispatch Limiter Set Point	Generating System Dispatch Limiter Set Point
Generating System Net Export Limiter Set Point	Generating System Net Export Limiter Set Point
Power Factor Set Point Control	Power Factor Set Point Control
Charge Rate Limiter for Energy Storage Systems (if required)	Charge Rate Limiter for Energy Storage Systems (if required)
Discharge Rate Limiter for Energy Storage Systems (if required)	Discharge Rate Limiter for Energy Storage Systems (if required)
Frequency response active import/export limit (if required)	Frequency response active import/export limit (if required)

5.1.4.10 Analogue Inputs to SA Power Networks

SA Power Networks expects to receive total generating system metering, including 3 phase volts (at the main bus and generating system), 3-phase Amps, kW, kVAr of the generating system (gross output) and connection point(s) (net output).

SCADA metering of individual generating units or of the total generating system measured downstream of the connection point shall be configured as shown in **Figure 3** with positive while generating and negative while absorbing active power. The sign of the corresponding reactive power shall be relative to the direction of active power flow such that a positive value shall indicate reactive flow in the same direction as active power flow whilst a negative value shall indicate reactive flows in the opposing direction to active power flows.

Net metering (where applicable) as seen at the connection point shall be positive for flows from the network through the connection point (ie whilst absorbing active/reactive power) and negative for flows to the network through the connection point (ie whilst exporting active/reactive power).

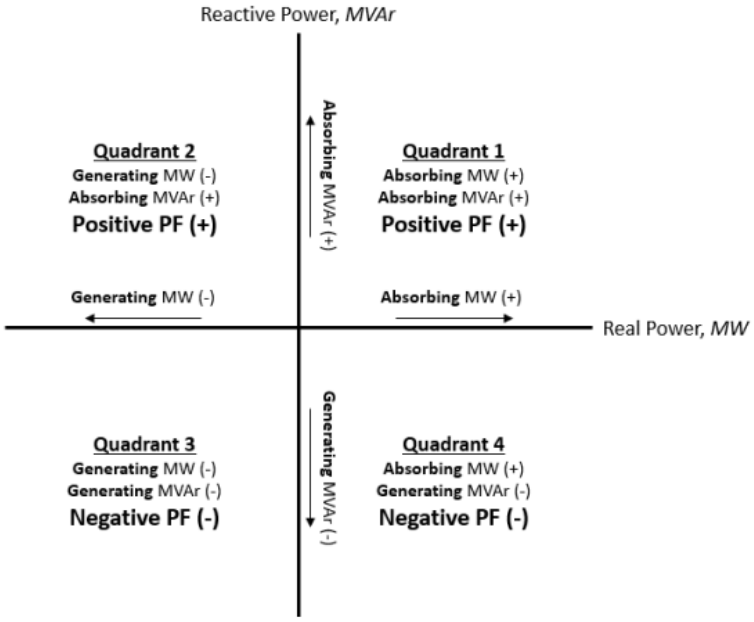

Figure 3 : Power Factor Sign Convention at the Customer Connection Point

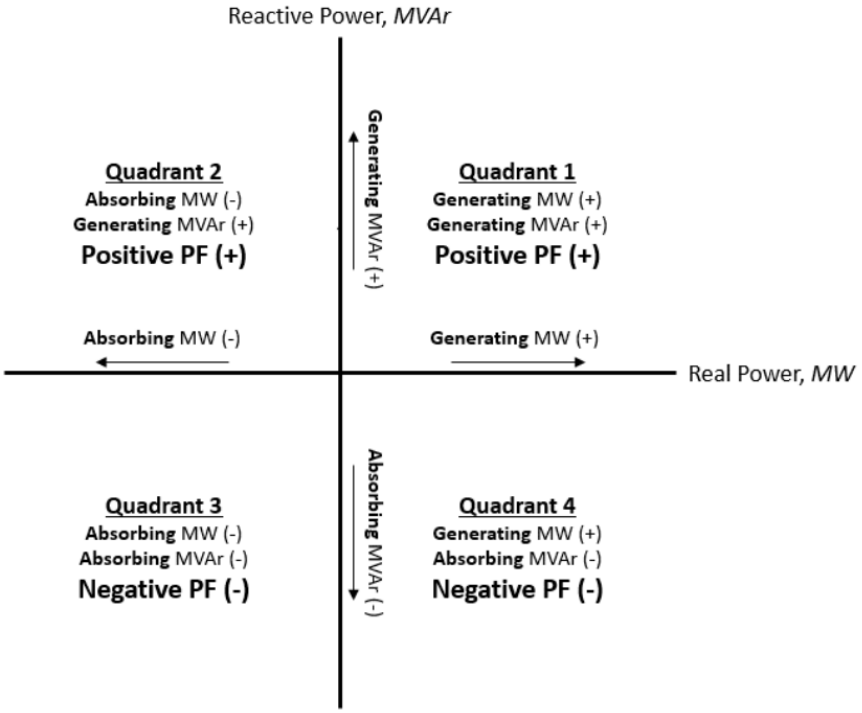

Figure 4: Power Factor Sign Convention at the Customer Generating Terminals

Where the generating system consists of more than one form of generation or technology, metering at individual generating unit level and/or at generation type summated level will be required in addition to generating system and connection point level. For example, where a site's generating system consists of multiple rotating generating units, PV generation and BESS, in addition to the total generating system and connection point values, SA Power Networks will requiring metering of:

- each individual rotating generating unit;
- the summated total output of the rotating generation;
- the total output of the PV generation;
- the total input / output to/from the BESS;
- the total generating system output; and
- the net export as seen at the connection point.
- When the site is supplied at HV, metering class VTs and CTs are to be used.

Table 6: SCADA Analogue Input Requirements (from generator to SA Power Networks)

Analogue Inputs for Simplified SCADA	Analogue Inputs for Full SCADA
Connection Point Active Power Output	Connection Point Active Power Output
Connection Point Reactive Power Output	Connection Point Reactive Power Output
Connection Point Power Factor	Connection Point Power Factor
Connection Point Current (three-phase Amps)	Connection Point Current (three-phase Amps)
Connection Point Voltage (three-phase Volts)	Connection Point Voltage (three-phase Volts)
Generating System Active Power Output	Generating System Active Power Output
Generating System Reactive Power Output	Generating System Reactive Power Output
Generating System Power Factor	Generating System Power Factor
Generating System Current (three-phase Amps)	Generating System Current (three-phase Amps)
Generating System Voltage (three-phase Volts)	Generating System Voltage (three-phase Volts)
	Number of Generating Units Connected[1]
Generating System Dispatch Limiter Feedback	Generating System Dispatch Limiter Feedback
Power Factor Set Point Control Feedback	Power Factor Set Point Control Feedback
Power Factor at the Connection Point	Power Factor at the Connection Point
Charge Rate Limiter for Energy Storage Systems Acknowledged (if required)	Charge Rate Limiter for Energy Storage Systems Acknowledged (if required)
Discharge Rate Limiter for Energy Storage Systems Acknowledged (if required)	Discharge Rate Limiter for Energy Storage Systems Acknowledged (if required)
Charge Status for Energy Storage Systems (if required)	Charge Status for Energy Storage Systems (if required)
Frequency Response Import/Export Limit (if required)	Frequency Response Import/Export Limit (if required)

Notes: If requested by AEMO

5.1.5 SCADA Communication Failsafe Operation

The failsafe signal will be the action when planned transfer to an abnormal feeder. When this is not specified, inverter-only generating systems will be issued a GDL 0, and generating systems with rotating generating units will be issued a 'permission denied'.

SA Power Networks proposes to have two modes of communications failsafe as shown in **Table 7**.

Table 7: Communication Failsafe Operations

	COMMUNICATIONS FAILURE	OPERATION
1	Failure of the SCADA communication link between the SA Power Networks' RTU and upstream Master Station communication link.	SA Power Networks' RTU will send a failsafe signal to the customer RTU upon waiting a pre-configured time interval (15–45 minutes) for communications to return (to prevent nuisance fail safe activation).
2	Failure of the SCADA communications link between the SAPN RTU and the customer's controller for more than 60 seconds (the Modbus communication link).	Customer's site controller must ramp to a GDL of 0kW and rotating generating units must disconnect from the Network, for which SA Power Networks will not be responsible for any losses (direct or indirect) incurred by the customer.

5.1.6 Wireless Communications

Where a generating system's protection relay (anti-islanding relay) and import/export monitoring device is remote from the EG system's isolating device, a wireless communication system contained within the customer's site may be used. The generating system's protection relay and import/export monitoring device utilising wireless communication link shall be the customer's responsibility and:

1. Have a fail-safe system disconnecting the generating system from the distribution network upon failure of any generating system protection relay's hardware/software; and
2. Disconnect the generating system from the distribution network for any loss of communications that would inhibit the correct operation of the protection system longer than 5 seconds.