NICC271 – BESS Connections

Network Information for Contractors and Customers

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SA Power Networks

Empowering South Australia

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1. Purpose

The National Electricity Market (NEM) is going through a rapid transformation and there has been an increasing level of interest in Battery Energy Storage System (BESS) connection proposals at distribution voltage levels, typically sub-5MVA in nameplate capacity.

This document has been developed to provide general guidance on the technical requirements and assessment criteria that specifically apply to customers seeking to connect BESS over 30kVA in nameplate rating to SA Power Networks' distribution network.

This document should be read in conjunction with SA Power Networks' Technical Standards (TS) and our Network Information for Contractors and Customers (NICC) which outline the technical and engineering requirements for embedded generating systems connecting to SA Power Networks' distribution and sub-transmission networks.

- TS132 Low Voltage Embedded Generation Connection Technical Requirements – Capacity above 30kVA
- TS133 High Voltage Embedded Generation Connection Technical Requirements
- TS134 Communications Systems (inc. SCADA) for Embedded Generation
- NICC270 Connection of Medium and Large Embedded Generation Greater Than 30kVA

2. Definitions and Abbreviations

2.1 Definitions

Authorised Service Capacity	The total capacity of the connection point including both firm and flexible load components that the site must not exceed.
Agreed Maximum Demand	The firm load for which the customer has paid ICSN charges and will be reserved for the customer.
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.
Energy Storage System	A system comprising one or more energy storage units
Firm	Capacity in reserved for the customer (including in demand/constraint forecasting) when SA Power Networks does network planning. However, it is not 'guaranteed', meaning that under different network scenarios capacity can still be curtailed to manage network requirements – normally during outage events
Flexible	Where the customer has agreed to dynamically adjust their import or export power profile to operate within network constraints.
Generator	A person who engages in the activity of owning, controlling or operating a generating system that is connected to, or who otherwise supplies electricity to, a transmission system or distribution system and who is registered by AEMO as a Generator under Chapter 2 of the NER.
High Voltage	Voltage exceeding Low Voltage
Low Voltage	Voltage exceeding 50V ac or 120V ripple free dc and not exceeding 1,000V ac or 1,500V dc
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.
Net Export Limit	A real power export limit value sent via a SCADA signal by the DNSP to be applied at the proposed generating system's connection point.
Net Import Limit	A real power import limit value sent via a SCADA signal by the DNSP to be applied at the proposed generating system's connection point.
Short Circuit Ratio	The synchronous three phase fault level (in MVA) divided by the rated output of an IBR generating system (in MW or MVA) measured at the generating system's Connection Point.

2.2 Abbreviations

AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AI	Analogue Input
AMD	Agreed Maximum Demand
AO	Analogue Output
ASC	Authorised Service Capacity
ASGU	Ancillary Service Generating Unit
BESS	Battery Energy Storage System
DER	Distributed Energy Resources
DI	Digital Input
DO	Digital Output
DRSP	Demand Response Service Provider
EMT	Electromagnetic Transient
FCAS	Frequency Control Ancillary Services
GPS	Generator Performance Standards
IBR	Inverter-Based Resource
ICSN	Incremental Cost Shared Network
MASP	Market Ancillary Service Provider
NEM	National Electricity Market
NEMDE	National Electricity Market Dispatch Engine
NER	National Electricity Rules
NICC	Network Information for Contractors and Customers
PSMG	Power System Model Guidelines
RMS	Root Mean Squared
RTU	Remote Telemetry Unit
SCADA	Supervisory Control and Data Acquisition
SCR	Short Circuit Ratio
SMIB	Single Machine Infinite Bus
TS	Technical Standard
VPP	Virtual Power Plant

3. Registration Requirements

3.1 Generator Registration

Generators intending to register with AEMO shall comply with the requirements of the National Electricity Rules (NER), the National Electricity Law (NEL) and the guidelines and specifications published by AEMO.

Exemptions from the requirements to register as a Generator may be granted by AEMO as outlined in the Generator Exemption and Classification Guide. This includes standing exemptions for any generating system with a total nameplate rating of less than 5MVA, that have retail arrangements in place with a Market Participant for the sale (export) or purchase (import) of electricity from the battery's connection point to the network.

BESS connections with a nameplate rating of 5MVA or more, must be registered as Generators with AEMO. Requirements to register the load component of the BESS as a market customer may apply when importing electricity from the grid.

Customers should review AEMO registration requirements and notify SA Power Networks their proposed registration category for the BESS at the time of connection application. This will assist with the application processes and technical assessments.

If the Customer intends to register as a Generator with AEMO, the connection will be subject to Rules 5.3 and 5.3A of the National Electricity Rules (NER) regardless of the total nameplate rating of the BESS.

Note: Customers exempt from the requirement to register as a Generator are not automatically exempt from the technical requirements in Schedule 5.2 of the NER and may be required to comply with certain technical requirements. Refer to Section 4 for details.

3.2 Frequency Control Ancillary Services

3.2.1 Regulation FCAS

Any BESS intending to participate in the Regulation FCAS market must be registered as a Generator and be classified as an Ancillary Service Generating Unit (ASGU) by AEMO to participate in central dispatch to deliver this service.

Access to the Regulation FCAS market is subject to successful establishment of an appropriate communication link between the customer's proposed Generating System, SA Power Networks and AEMO.

3.2.2 Contingency FCAS

Any BESS intending to participate in the contingency FCAS market must be registered as a Generator and classified as an ASGU by AEMO. Alternatively, customers may enter an appropriate arrangement with an existing Market Customer or a Demand Response Service Provider (DRSP) and apply to AEMO for approval to classify the Connection Point as an Ancillary Services Load (ASL) to participate in this service.

Note customers intending to register the BESS as a Generator for the purpose of participating in contingency FCAS are subject to technical assessments outlined in Schedule 5.2 of the NER regardless of their nameplate rating.

Alternative registration arrangements for contingency FCAS participation may be available to smaller scale BESS such as a Virtual Power Plant (VPP) arrangement through existing VPP providers and market Small Generation Aggregators.

SA Power Networks recommends that BESS customers intending to participate in FCAS familiarise themselves with the registration requirements for FCAS participation to determine an appropriate registration pathway for the proposed BESS connection and notify SA Power Networks at time of connection application.

The flowchart below provides a summary of the registration requirements for BESS intending to participate in the FCAS markets.

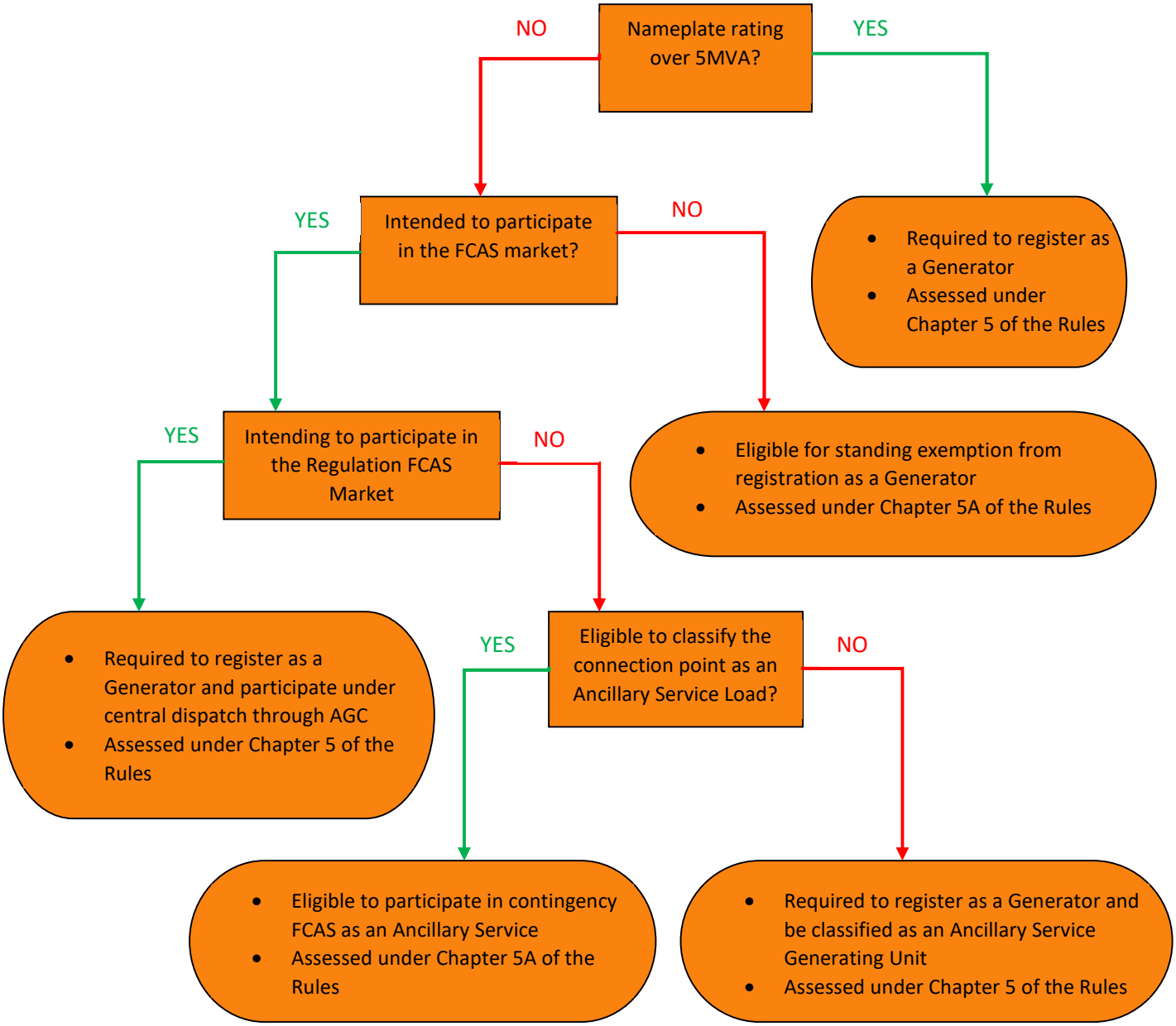

Figure 1: Flowchart of registration requirements for BESS intending to participate in the FCAS markets

4. Technical Requirements

4.1 Modelling Requirements

SA Power Networks may require power system model representation of the generating system in PSS/E and/or PSCAD format to be submitted as part of any high voltage generating system connection proposal. Refer TS133 for details on all modelling requirements.

Customers intending to register as a Generator or proposing to connect BESS with nameplate rating of 5MVA and above will be subject to AEMO's modelling requirements outlined in the *'Power System Model Guidelines'* (PSMG) and '*Dynamic Model Acceptance Test (DMAT) Guideline'*.

4.2 Frequency Control Ancillary Services

Additional modelling requirements apply to systems proposing to participate in the Frequency Control Ancillary Services (FCAS) market as detailed in AEMO's *'Battery Energy Storage System Requirements for Contingency FCAS Registration'*.

The BESS operator seeking to provide contingency FCAS must engage AEMO to agree on the type of controller and determine appropriate settings, then use a sufficiently accurate model on PSCAD, PSSE or Simulink to simulate a frequency disturbance to provide data that demonstrates the active power response. The models and simulation outputs must be submitted to AEMO and SA Power Networks for review prior to commissioning of the generating system. The active power response to a frequency disturbance must be demonstrated as part of on-site commissioning which will be used to finalise the maximum ancillary service capacity of the BESS.

Customers must ensure that SA Power Networks' dynamic net export and import limits at the Connection Point as set by SA Power Networks' Network Operation Centre (NOC) are respected at all times. The net export and import limits at the connection point may not be exceeded, even during delivery of FCAS, unless a separate higher Frequency Response Export and Import Limits are defined by SA Power Networks as defined in Section 6.2. This function must be demonstrated as part of site witness commissioning.

The Customer will be responsible to have appropriate processes and systems in place to rebid their availability in AEMO's market systems in the instance where the frequency response from the generating system needs to be curtailed due to network limitations and constraints.

4.3 Generator Performance Standards

Customers intending to register as a Generator or proposing to connect BESS with a nameplate rating of 5MVA and above will be required to establish a set of agreed Performance Standards in line with the full requirements of Schedule 5.2 of the NER.

Partial exemption from the full technical requirements of Schedule 5.2 may be granted for BESS registered as a Generator with a nameplate rating of less than 5MVA at the discretion of SA Power Networks, provided the generating system is proposing to connect in areas with adequate system strength. Scope of studies for such systems may include but not be limited to:

- S5.2.5.3 – Generating Unit Response to Frequency Disturbances
- S5.2.5.4 – Generating Unit Response to Voltage Disturbances
- S5.2.5.5 – Generating Unit Response to Disturbances following Contingency Events (limited)
- S5.2.5.11 – Frequency Control
- S5.2.5.14 – Active Power Control

4.4 Ramp Rates

The voltage changes from various loading / unloading rates and its resulting impact on the network voltage control systems form a part of SA Power Networks' connection assessments.

Battery systems are especially unique in the sense that they are capable of ramping extremely fast in response to pricing signals and their operation cannot be readily forecast.

To ensure that there is no adverse impact on the network voltage control systems, the maximum allowable rate at which the battery units can be loaded and unloaded for steady state market operation shall not exceed 16.67% of rated power of the battery per minute, as per *AS/NZS 4777.2* unless advised otherwise by SA Power Networks.

The above ramp rates apply for steady state market operation and may be temporarily exceeded under the following scenarios:

- generator runback for overloads;
- compliance with site export/import limits;
- delivery of frequency response (e.g. Primary Frequency Response and C-FCAS);
- responding to power quality demand response modes (e.g. Volt-Watt and Volt-VAr);

Compliance with these requirements must be demonstrated as part of the site witness commissioning.

5. Load Assessment and Customer Payments

SA Power Networks consider battery systems as load when charging from the network and as embedded generation when discharging into the network. Please refer to SA Power Networks' Connection Policy document for details on how the load component of the battery systems are assessed and charged.

Customers must ensure their control systems meet import limits that are specified in the engineering assessment and/or limits set by SA Power Networks SCADA controls. Additional charges may be applied should the site exceed the Agreed Maximum Demand (AMD) or Authorised Service Capacity (ASC) due to concurrent charging operation of BESS with existing load. These requirements are put in place to ensure a reliable network is maintained for all SA Power Networks' customers.

6. SCADA Monitoring and Control Requirements

The nameplate rating and operational requirements of the proposed embedded generating system in relation to the characteristic of the distribution network at the Connection Point influence the actual interface and communication requirements.

Typical requirements for communication systems for embedded generators connecting to SA Power Networks including SCADA monitoring and control are outlined in our technical standard TS134: Communication Systems (inc. SCADA) for Embedded Generation.

The following additional SCADA monitoring and control requirements may apply for BESS connections depending on the operating philosophy of the proposed BESS.

6.1 Net Import Limiter

Net Import Limiter (kW) (AI and AO) is an analogue control setpoint required by generating systems capable of taking load from the Network (e.g. BESS), used to dynamically limit the import from the network at the Connection Point. The net import limiter will consist of a control signal that will be initiated manually by SA Power Networks' NOC and transmitted to the generating system via SCADA to constrain the net site import at the Connection Point, which will take consideration of the firm agreed maximum demand of the Connection Point and network availability.

6.2 Frequency Response Net Export/Import Limiter

Generating Systems intending to deliver frequency support services such as FCAS may be eligible for Frequency Response Net Export and Import Limiter signals (kW) (AI and AO) at the Connection Point which can enable the generating system to transfer additional power beyond the normal net export and import limits at the Connection Point during delivery of frequency support services.

Frequency response net export/import limiter signals may be applied under following scenarios:

- Nameplate rating of the proposed generating system exceed the normal ratings of SA Power Networks' upstream distribution assets; or
- Permissible export/import (accounting for existing load, AMD and reactive support) at the Connection Point is below the nameplate rating of the generating system; or
- Network contingencies where the generating system may be constrained from exporting under normal scenarios but permitted to export when providing an FCAS response; or
- On customer request based on review of the site-specific operating philosophy.

The customer's control system must be capable of accepting frequency response net export / import limits at the Connection Point from SA Power Networks' Network Operation Centre via SCADA and ensure these limits are not exceeded during delivery of frequency response services, which is to be demonstrated as part of site witness commissioning activities.

6.3 Frequency Response Active

Frequency Response Active (On/Off) (DI) is a feedback signal which provides an indication of whether the generating system's frequency response function is active. This signal is required for generating systems intending to deliver frequency support services such as FCAS.

6.4 Energy Storage System Charge Status

Energy Storage System Charge Status (%) is a feedback signal which provides the charge status of the energy storage systems connected to SA Power Networks' distribution network.