TasNetworks Standard

Embedded Generation Anti-Islanding Scheme

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Tasmanian Networks Pty Ltd (ABN 24 167 357 299)

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Responsibilities

This document is the responsibility of the Secondary Systems Asset Management, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

Please contact the Leader Secondary Systems Asset Management with any queries or suggestions.

- Implementation All TasNetworks staff and contractors.
- Compliance All Hofs and Team Leaders.

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Record of revisions

Version	Description	Date
1.0	Original issue	19/06/2020
1.1	Document restructured Risks detailed AIS types expanded Roles and responsibilities added 'Embedded Generation Anti-Islanding Standard - Amendment 1' and 'Embedded Generation Anti-Islanding Standard - Amendment 2' incorporated.	25/08/2023
2.0	Document reviewed and improved clarity. Added flowchart to broadly describe the internal TasNetworks workflow from submission of application for embedded generation new connection to acceptance of design and commencement of work planning.	22 October 2025

Contents

Acronyms

Table 1: Acronyms

Acronyms	Expansion
4G-CAIS	Low reliability 4G Inter-trip CAIS
ACR	Automatic Circuit Recloser
AIS	Anti-Islanding Scheme
SFAIRP	So Far As Is Reasonably Practicable
CAIS	Communications-based Anti-Islanding protection Scheme
CB	Circuit Breaker
DER	Distributed Energy resources
DNSP	Distribution Network Service Provider
EG	Embedded Generator
I-CAIS	Instantaneous inter-trip CAIS
JOP	Joint Operating Procedure
LLB	Live Load Blocking
LV	Low Voltage (≤1 kV)
MV	Medium Voltage (1 kV – 66 kV)
NER	National Electricity Rules
NOCS	Network Operations and Control System
NVD	Neutral Voltage Displacement
P&C	Protection and Control
PMU-CAIS	Phasor Measurement Unit CAIS
POC	Point of Connection
ROCOF	Rate of Change of Frequency
RP-AIS	Reverse Power AIS
SCADA	Supervisory Control and Data Acquisition
SPS	Special Protection Scheme
VT	Voltage Transformers

1 General

1.1 Purpose

This standard defines the anti-islanding protection requirements that must be satisfied to approve the connection of Distributed Energy Resources including Embedded Generator (**EG**), to the Tasmanian Low Voltage (**LV**) and Medium Voltage (**MV**) Electricity Distribution Network, owned and operated by Tasmanian Networks Pty Ltd (hereafter referred to as TasNetworks). These requirements are intended to ensure due diligence (duty of care) requirements have been met to allow the connection of a new EG to the Tasmanian Electricity Distribution Network.

1.2 Scope

This standard applies to new EGs connected to the Tasmanian Distribution Network. This standard does not cover generator connections to the Tasmanian Transmission Network.

1.3 Objective

This standard is intended for an internal TasNetworks audience to develop the Anti-Islanding Scheme (**AIS**) for new customer connections, or an upgrade to an existing embedded generator connection. The standard will be made available to proponents so that they are aware of why the AIS may be required to support their proposed connection.

1.4 Precedence

Any apparent conflict between the requirements of this standard and applicable laws, mandatory requirements, industry standards, project specifications, non-statutory standards or guidelines, and any other associated documents should be promptly brought to the attention of TasNetworks for resolution. No actions shall be taken that may result in a breach of law or mandatory standards.

In case of conflict:

a) If a conflict arises with a law, mandatory standards, or industry standard, the law or statutory requirement will take precedence over this standard.
b) If a conflict arises with a non-mandatory standard or guideline, this standard will take precedence over that non-mandatory standard or guideline.
c) If a conflict arises with TasNetworks' standards or project specifications, a deviation must be explicitly requested and approved in writing by TasNetworks' Asset Management, Leader Secondary Systems.

Approval for a deviation will only be granted if it maintains the required quality of workmanship, does not pose safety risks to personnel or equipment, and remains consistent with the intent of this standard.

2 References

As a component of the complete specification for a system, this standard is to be read in conjunction with other applicable standards and documents. The following documents are particularly relevant:

2.1 TasNetworks' Embedded Generation Technical Requirements

Table 1 - TasNetworks' Embedded Generation Technical Requirements

Record Number	Embedded Generation Technical Requirements	Voltage
R0002006753	Medium Voltage Embedded Generation Technical Requirements	Up to 66kV
R0002006770	Low Voltage Embedded Generation Technical Requirements	230V line neutral or 400V line-line

2.2 Australian Standards and Codes of Practice

Table 2 - Australian Standards and Codes of Practice

Record Number	Document Name	Organisation	Dated
AS/NZ 4777.1	Grid connection of energy systems via inverters Installation requirements	Standards Australia	2024
AS/NZ 4777.2	Grid connection of energy systems via inverters Inverter requirements	Standards Australia	2020

BACKGROUND

3 Embedded Generation Causing Islanding of a Network

The connection of an EG to the distribution network introduces new risks to the network that TasNetworks is obligated[1,2] to reduce following the 'So Far As Is Reasonably Practicable (**SFAIRP**)' principle (Section 6). These risks primarily occur as a result of the disconnection of the generator or energy resource from the local distribution network and from the national grid, the subsequent risk associated with reconnection to the network, and the management of TasNetworks obligations within the resulting islanded network (Section 4.3.2).

The TasNetworks Network Planning team will specify, within the applicable Connection Capability Report, if an Anti-Islanding Scheme (**AIS**) is required under this standard for the connection of a proposed embedded generator in order to manage risks introduced by the connection (Section 12).

The islanding of an EG can occur if it is disconnected from the distribution network because of a fault occurring within the network. When a fault occurs, the resulting fault current will be detected by an upstream protection system which will automatically open a local device to disconnect the faulted section from the grid. This operation will island (i.e. isolate) any EGs, connected downstream of the device, together with locally connected load customers.

Whilst the fault is present within the islanded network, the local embedded generator will supply the fault. This fault current from the generator may not be sufficient to activate the protection elements within the islanded network[3]. Consequently, the fault may persist within the island, with the generator supplying it as if it was a load. This continued supply to the faulted section of the island may increase the severity of the fault as well as the risk to TasNetworks personnel and the public.

The risk of a persistent fault within the islanded network is increased by the TasNetworks requirement for the EG earth system to be ungrounded when running in parallel with the TasNetworks grid[4]. This configuration ensures that the addition of an EG will not raise earth fault levels, in the distribution network, by preventing the EG from supplying zero sequence current. However, reactive fault current may flow from the EG because of the capacitance of a downed conductor to the general mass of earth. This can create an increased risk to TasNetworks personnel and the public in the area of the fault.

Following the creation of the EG island the entire load in the island will be transferred to the EG, whilst any load in the national grid will be removed from the generator. This change in load will typically result in a load/generation imbalance within the island, resulting in an increase, or decrease, in frequency. Additionally, with the loss of the reference to the national grid, voltage supplied by the EG to the island will likely deviate from its nominal value. These deviations could result in values exceeding the limits prescribed in the National Electricity Rules (**NER**)[5].

The loss of the frequency reference provided by the national grid, and change in frequency in the island, will result in the island losing synchronisation with the national grid. An auto-reclose operation by the device that disconnected the fault, would result in the reconnection of the unsynchronised island to TasNetworks distribution network and to the national grid. This may result in high transient voltages within the distribution network risking the safety of customers, TasNetworks personnel, and damage to

1 Work Health and Safety Act 2011 A2011-35

2 Work Health and Safety Act 2012(Tas) Division 2

3 This risk is exacerbated when the generator has low inertia.

4 Medium Voltage Embedded Generation Technical Requirements - Section 5.10 Earthing

5 NER S5.1.3 and NER S5.1.4(c)

connected equipment. For rotating machines, the high reactive power flow from the electrical generator required to supply these voltages may lead to high mechanical forces on the stator winding and damage to the generator shaft. Additionally, the sudden change in rotational speed of the EG, as the power system pulls the EG into alignment, may damage the rotor and shaft body.

The outcomes detailed above may result in significant damage to the EG, electrical network, and/or customer plant connected to the network. The outcomes also risk the safety of the public and TasNetworks personnel. TasNetworks requires that these risks, introduced to the network because of an EG connection, be mitigated so far as reasonably practicable. The implementation of an AIS is intended to mitigate and manage all of these risks.

4 Function of Anti-islanding scheme explained

The main function of an AIS is to prevent the adverse consequences and resultant damage to the EG, the distribution network and customer plant connected to the network, when part of the distribution network where the EG is connected is disconnected or islanded due to a fault. An AIS is intended to disconnect and reconnect (after the fault is cleared) an islanded part of a distribution network only when the islanded network is synchronised, stable and meets power system conditions of the wider distribution network.

Anti-islanding protection schemes can be grouped into three main types:

- Passive anti-islanding protection;
- Active anti-islanding protection; and
- Communications-based anti-islanding protection.

4.1 Passive protection

Passive anti-islanding protection monitors the electrical output of the generator at the power station or at the point of connection of the EG. Passive anti-islanding protection elements include[6]:

- under and over frequency;
- under and over voltage;
- Rate of Change of Frequency (ROCOF); and
- voltage vector shift protection.

TasNetworks has found that the selection of settings for voltage vector shift and rate of change of frequency, that are both sensitive to react to islanding events and at the same time stable for adjacent network faults, are difficult to achieve in the Tasmanian network. If these settings where enabled, it is expected to result in spurious generator trips which are not consistent with the fault ride through requirements specified in the NER[7]. The remaining passive protection elements operate by detecting a change in the voltage and frequency of the generator at the point of connection, in response to an islanding event. However, the islanding event would not be detected by the passive anti-islanding protection if the load present on the island is perfectly matched to the load being supported by the generator, prior to the islanding event, since the output of the generator will not change. Additionally, this form of protection also includes an inherent time delay for the change in the generators response to reach predefined thresholds.

6 Medium Voltage Embedded Generation Technical Requirements - Section 5.2.5.1 Passive anti-islanding protection.

7 NER S5.2.5.5 - Generating system response to disturbances following contingency events.

4.2 Active protection

Active anti-islanding protection detects the absence of a connected grid by injecting or changing the performance of the EG then monitoring the impact to the connected network. For example, if an EG was able to shift the frequency of the power network it would signify that it was islanded. Active anti-islanding protection is well developed within solar panel inverters, and forms part of Australian Standards for inverter design[8,9]. Typical methods for this type of protection include but are not limited to:

- frequency shift,
- frequency instability,
- power variation and
- current injection.

The application of this form of protection at any point other than the generator has not been proven reliable. Therefore, its implementation is reliant on the correct operation of the proponent's equipment.

4.3 Communications-based protection

A Communications-based Anti-Islanding protection Scheme (**CAIS**) is utilised to support a passive AIS. Specifically, to cover passive anti-islanding protection blind spots such as a load and generation balance in the EG island.

A CAIS utilises a high-speed communication system to monitor all automatic upstream devices within the electrical network. These points are analysed by an island detection algorithm to determine when an island condition exists. When an island condition is asserted, the algorithm sends a signal to open the Point of Connection (**POC**) Automatic Circuit Recloser (**ACR**) or circuit breaker and isolate the EG from the network.

Examples of communications-based anti-islanding protection include inter-trips and synchro-phasors.

The failure of a CAIS is a credible contingency event which may prevent the EG from being disconnected following an islanding event. Where the reliability of the elements that form the CAIS cannot be guaranteed to fail-safe, such as using a third-party communications bearer, a CAIS may be supported with the additional protection elements detailed in the following sections.

4.3.1 Live-load blocking

The failure of a CAIS presents a risk that auto-reclose schemes may close onto the unsynchronised island[10]. To ensure that the power system remains in a secure operating state, following a communications-based AIS failure, the NER requires that the upstream feeder CB and ACRs are fitted with Live Load Blocking (**LLB**)[11] capability. The implementation of LLB will prevent the local device from re-closing if the EG is connected to the network.

LLB can be implemented with either of the following methods:

8 AS/NZ:4777.1 (2016) and AS/NZ:4777.2 (2015).

9 There are currently no Australian Standards that have been developed for active anti-islanding protection of synchronous generators. If the synchronous EG is capable of active anti-islanding protection its implementation will be assessed by TasNetworks.

10 Typically ACRs are set with a deadtime of 5s, (TasNetworks Distribution Protection and Automation Standard), however feeder circuit breakers are set with 20s deadtime (TasNetworks Protection of HV Busbars and Feeders Standard)

11 NER S5.1.11 [7] Automatic reclosure of transmission or distribution lines.

- Voltage sensing: Inhibiting the closure of the device if voltage is present on its downstream terminals; or
- Interlocking: Inhibiting the closure of the device by interlocking with the POC ACR, preventing re-close of the device when the POC ACR is closed.

TasNetworks will not consider disabling, or altering, the existing auto-reclose functions in the network to allow the connection of an EG as this will reduce the reliability to regulated customers[12].

4.3.1.1 Voltage sensing

LLB will inhibit the automatic operation of its associated device when a load side voltage is detected.

Voltage sensing LLB is available in the current TasNetworks standard ACRs through a setting change, however, additional hardware may need to be installed to enable this function on legacy assets. Feeder CBs, located in upstream substations, typically do not have Voltage Transformers (**VT**s) installed on their load side. If required the installation of a load side VT, or a suitable voltage presence device[13], to enable LLB function will form part of the connection charges incurred by the proponent[14].

If the TasNetworks designers determines that LLB cannot be installed on a feeder CB, the installation of a new recloser may be considered[15]. This recloser would be utilised to relocate the auto reclose and LLB functions from the feeder CB to the recloser. In this case the recloser must be installed downstream of the feeder circuit breaker without any tees between the two devices. The auto-reclose functionality must be disabled, and locked out, on the feeder CB and auto-reclose and LLB enabled on the recloser. The new recloser must be installed as close as practicable to the feeder circuit breaker to reduce the section of feeder that is not covered by auto-reclose.

4.3.1.2 Interlocking

Interlocking LLB may be provided between each automatic device in the CAIS and the POC ACR. This interlock will ensure that none of the automatic devices are reclosed whilst the POC ACR is closed. The communications bearer utilised to facilitate interlocking LLB must, be independent of the island detection algorithm, supervised at the POC ACR and trip the POC ACR instantaneously upon failure[16].

A review of the automatic protection schemes is to be undertaken to ensure that the LLB signal is received at the automatic device prior to the automatic re-close dead time of each device.

4.3.2 Neutral Voltage Detection

As the step up transformer connecting the EG to the grid is generally ungrounded on the grid side, an earth faults on the distribution network cannot be reliably detected and cleared by standard protection elements within the islanded network by the embedded generator. Consequently, the EG is reliant on the operation of the CAIS to disconnect the generator.

If the reliability of the CAIS cannot be guaranteed, then Neutral Voltage Displacement (**NVD**) protection element must be utilised to disconnect the EG if an earth fault is detected on an unearthed system. NVD

12 Unless the EG is connected via dedicated feeder with no other customers.

13 If a voltage presence device, i.e. Voltage detection Indicator (VDI), is utilised it must be shown that any risks introduced by the use of this device are reduced SFAIRP.14 If a high reliability communication path exists between the POC and the NOCS, and the upstream feeder circuit breaker and the NOCS, TasNetworks may choose to waive the requirement for LLB at the upstream feeder circuit breaker.

14 If a high reliability communication path exists between the POC and the NOCS, and the upstream feeder circuit breaker and the NOCS, TasNetworks may choose to waive the requirement for LLB at the upstream feeder circuit breaker.

15 The installation of a recloser for this function must be approved by the appropriate TasNetworks recloser asset owner.

16 Interlocking LLB is not acceptable via a 4G communications bearer (section 8.2).

utilises voltage transformers to monitor the neutral displacement voltage to detect if an earth fault is present in the distribution network. When an earth fault is detected, the NVD protection scheme will pick up and disconnect the generator from the network after set time delay[17]. However, NVD will not detect multi-phase fault.

4.3.3 Fail-safe communications bearer

A CAIS is reliant on the communications bearers between the islanding algorithm and the devices that are monitored (upstream automatic devices) and controlled by the algorithm (POC ACR). Consequently, the loss of any one of these communications bearers would affect the operation of the CAIS scheme.

To ensure that the EG is not connected to the network without an operational CAIS the scheme is to be supported by a self-trip function. This function isolates the generator from the network if communications from any element of the CAIS to the island detection algorithm are lost. It is therefore essential that a reliable communication bearer is used to avoid tripping of the EG due to loss of communication connection.

5 Network Islanding Risk Analysis

The requirement for an AIS, detailed in this standard, is intended to address the following risks to the network introduced by the connection of an EG:

1. Reconnection of an unsynchronised EG island to the grid;
2. Technical parameters (i.e. voltage and frequency) not maintained within their permitted limits[18];
3. Clearance of a persistent earth fault within the islanded network;
4. Clearance of a fault within the islanded network; and
5. Material degradation in the quality of supply to other regulated customers[19].

The risks listed above can be mitigated through the instantaneous operation of a CAIS. The consequence of a failure of the CAIS, or delay in its operation, are discussed in the following sections.

5.1 Unsynchronised reconnection

The implementation, and successful operation, of LLB will ensure that the automatic operation of a device does not result in the reconnection of an unsynchronised island to the national grid (item 1). However, if a reclose operation is blocked at the primary substation, it would result in reduced quality of supply to other regulated customers (item 5). Consequently, LLB cannot be relied upon as a primary means to address this risk, instead it is considered as a backup to the CAIS. In the case where it is impossible to implement LLB, the A/R functionality shall be disabled

5.2 Technical parameter limits

An islanding event would prevent TasNetworks from discharging its obligations to the regulated customers inside the islanded section of the network, because once islanded, TasNetworks would not be able to ensure the parameters for the power system stability can be maintained within their permitted limits at all

17 A time delay is required to ensure that system disturbances do not result in the activation of this NVD protection function. An appropriate time delay will be set by TasNetworks Secondary designers dependant on the specific area in the network where the EG is connected.

18 NER S5.1.3 and NER S5.1.4(c)

19 NER S5.2.1 Outline of requirements

locations within the islanded network (item 2). The duplication of passive anti-islanding protection (i.e. under and over voltage and frequency) on TasNetworks owned equipment at the POC can provide some control to improve assurance to meet quality of supply to TN regulated customers within the islanded network.

5.3 Persistent earth fault

If an earth fault persists in the network, following the creation of an island, earth fault current will not be supplied by the EG as the generator step-up transformer is ungrounded[20]. However, the capacitance associated with the energised network, can result in the generation of capacitive fault current flowing through the capacitance of healthy phases and thus poses a human safety issue. The implementation of NVD protection at the POC is intended to detect and remove this type of fault from the network. However, there may be situations where the earth fault does not cause a shift in the neutral point of the voltage triangle, and as a result, it may not be cleared by NVD protection.

5.4 Fault clearance

If a phase to phase, or three phase fault persists in the island, or a second fault occurs in the island, this fault may appear as a load to the protection remaining in the island and not be tripped (item 4). If this situation occurs, the supply of this fault by the EG may put TasNetworks personnel and the public at increased risk. Additionally, the supply of the fault may affect voltage levels within the island which can cause damage to customer plant connected to the island (item 2). It should be noted that the fault may result in disruption of the load generation balance and result in the EG being removed from the network due to under frequency protection. The protection system of the EG should be designed to clear these fault based on appropriate system studies, reviewed and approved by TasNetworks.

5.5 Residual Risks

The residual risks, known to TasNetworks, following the implementation of a CAIS are detailed below in Table 3. These risks assume a failure of the CAIS, resulting in the disconnection of the EG, after the POC self-trip on loss of communications time has elapsed.

Table 3 – Residual Risks

Hazard	Risk Control	Residual Risk Description	Residual Risk Consequence
Reconnection of an unsynchronised EG island to the national grid	LLB	The failure of LLB can result in the connection of the unsynchronised island to the national grid.	Damage to Equipment
Material degradation in the quality of supply to other regulated customers	N/A	The operation of LLB, to prevent the connection of an unsynchronised island, would prevent customers from being restored by an auto reclose operation.	Increase customer outage times
Persistent earth fault	NVD	There may be situations where the fault does not shift the neutral point and is not cleared by NVD protection. These faults may persist in the network until the POC loss of communications time elapses.	Earth fault is not cleared resulting in a fatality

20 MV EG Connection Requirements - clause 5.10

Hazard	Risk Control	Residual Risk Description	Residual Risk Consequence
Fault clearance	Network Protection Elements	Faults present in the islanded network may appear to protection elements as a load and may not be cleared until the POC loss of communications time elapses.	Fault is not cleared resulting in a fatality

The risks detailed above can be mitigated by ensuring that the CAIS self-trip function is reliable, failsafe and acts instantaneously to remove the EG from the network.

The AIS STANDARD

6 So far as is reasonably practicable principle

The risks introduced by the connection of an EG to the network, as discussed in Section 5, shall be mitigated in accordance with the 'So Far As Is Reasonably Practicable' (SFAIRP) principle[21,22]. SFAIRP is a precautionary risk management approach which ensures the implementation of all reasonably practicable precautions required to fulfil a duty holder's due diligence requirements under Australian Law[23,24]. The SFAIRP process involves the following steps:

1. Hazard identification: Identifying all potential hazards associated with the connection of an EG.
2. Identification of practicable precautions: Determining all available precautions for each identified hazard.
3. Determination of reasonableness: Assessing the practicable precautions and determining which ones are considered reasonable under Australian Law.
4. Implementation of reasonable precautions: Implementing the precautions deemed reasonable according to Australian Law.

In cases where a proponent can demonstrate that providing a CAIS with instantaneous, fail-safe, self-trip functionality is grossly disproportionate to the benefit gained[25], TasNetworks will consider allowing the connection of the generator under a reduced standard.

7 Protection requirements

As the connecting Distribution Network Service Provider (**DNSP**), TasNetworks requires all EGs capable of forming a viable island[26] to be supported by an AIS in accordance with S5.2.5.8(c) of the NER.

The AIS shall comply with the following requirements set by TasNetworks:

1. Passive anti-islanding protection must be installed on the EG, including[27]:
    a. Under and over frequency protection
    b. Under and over voltage protection
    c. Voltage vector shift and rate of change of frequency protection must not be enabled.
    d. Passive anti-islanding protection must be duplicated on the TasNetworks side of the POC.
2. Active anti-islanding protection must be installed where it is supported by available technology, such as inverter-based EGs[28]. In connections where a Grid Forming Inverters (GFM) are used, additional analyses must be considered.

21 SFAIRP vs ALARP, Robinson, R & Francis, G dated 2014-05 - CORE 2014

22 The legal context to quantified risk assessment 31/03/2017

23 Work Health and Safety Act 2011 A2011-35, Republication No 26, 9 June 2023, Part 2

24 Work Health and Safety Act 2012(Tas) Division 2, Section 19

25 Work Health and Safety Act 2011 A2011-35, Republication No 26, 9 June 2023, Section 18(e) and according to established legal precedent.

26 As determined by TasNetworks

27 Medium Voltage Embedded Generation Technical Requirements - Section 5.2.5.1 Passive anti-islanding protection.

28 AS/NZ:4777.1 (2016) and AS/NZ:4777.2 (2015).

3. Where TasNetworks Network Planning team has determined that passive protection alone cannot prevent the formation of an EG island in all network configurations, and where TasNetworks Network Planning team has identified a network configuration where an island condition may exist; a CAIS must be installed.

   The CAIS must:

   a. Trip the POC ACR as fast as practicable[29] following the formation of an island;
   b. Have a fail-safe trip time that operates as fast as practicable[30];
   c. Not require interfacing with the customer's equipment.
   d. Be supported by the implementation of LLB on all automatic devices, upstream of the POC, automatic operation may result in the connection of two unsynchronised networks[31]. LLB should inhibit the automatic operation of its associated device when a voltage of 0.1 Per Unit, or greater, is detected.
4. Non-exporting EGs require the installation of low forward power or reverse power protection at the POC. However, application of run-back scheme shall also be considered to avoid spurious disconnection from the network.
5. The AIS design, procurement, installation, and commissioning shall be carried out by TasNetworks and funded by the proponent as part of the connection charges.

8 Communication-based AIS types

A communications-based AIS can take one of the following types.

1. I-CAIS: Instantaneous inter-trip CAIS (recommended)
2. 4G-CAIS: Low reliability 4G Inter-trip CAIS (not recommended in areas with weak 4G service)
3. PMU-CAIS: Phasor Measurement Unit CAIS
4. Each of these schemes is discussed in the following sections.

The application of fibre optic and 5G technologies can be consider with the above schemes.

8.1 Instantaneous inter-trip CAIS (I-CAIS)

8.1.1 Island detection algorithm (I-CAIS)

An Instantaneous inter-trip CAIS (**I-CAIS**) will utilise an island detection algorithm to monitor all automatic devices, upstream of the EG POC, whose operation may result in the formation of a viable island. The detection of a viable islanding condition will result in the instantaneous disconnection of the EG from the network.

The status of all upstream devices shall be sent to the island detection algorithm as protection inter-trips.

Site specific logic shall be configured to identify when the EG has been islanded based on the status of upstream automatic devices, Circuit Breakers (**CB**s) and ACRs[32].

29 Normal trip of the POC ACR by the CAIS shall follow the SFAIRP principle, refer to Section **Error! Reference source not found.**. Note active protection requires a trip time of 2 s econds AS:4777.2 Section 7.3

30 Loss of communications trip time will follow the SFAIRP principle, refer to Section **Error! Reference source not found.**.

31 Not required with the installation of a Reverse Power AIS as detailed in Section 9.

32 Non-automatic devices are to be managed by the TasNetworks control room and are not to be included in the island detection algorithm.

The island detection algorithm shall be located within hardware installed in a secure TasNetworks facility, typically the upstream substation, and shall be independent of the TasNetworks Network Operations and Control System (**NOCS**).

The algorithm will only be implemented for 'normal' operating conditions. If TasNetworks requires alternative switching arrangements, or the network is experiencing outages, the generator will be taken offline until 'normal' operating conditions are restored.

8.1.2 Fail-safe operation (I-CAIS)

To ensure reliable operation, continuous monitoring and self-supervision functions shall be employed to oversee the equipment and communication bearers that the I-CAIS relies on, including the islanding algorithm itself. If any component of the I-CAIS fails, the island detection algorithm shall trigger the disconnection of the EG within 200ms[33] of the failure. However, this timing shall be verified and confirmed for each installation.

8.1.3 Point of connection (I-CAIS)

To facilitate the I-CAIS, a telemetered device, typically an ACR, shall be installed on the TasNetworks side of the POC. This device, owned by TasNetworks, plays a crucial role in the I-CAIS by isolating the EG when the island detection algorithm identifies an islanding condition. It eliminates the need for direct interface between the I-CAIS and the EG system.

The POC ACR shall be configured with the following:

- Protection elements to detect positive and negative sequence faults on the upstream feeder fed from the EG;
- NVD to detect zero sequence voltage ~~fault currents;~~
- Passive anti-islanding protection to duplicate the passive islanding protection installed within the EG protection relay; and
- LLB is to be enabled to prevent the POC recloser from closing if the EG is online.

8.1.4 Automatic devices (I-CAIS)

The upstream automatic devices, that form part of the I-CAIS, shall have LLB installed and enabled.

8.1.5 Communications bearer (I-CAIS)

To allow for instantaneous operation of the scheme, the communications links that make up the I-CAIS shall be provided by a reliable high-speed communications bearer with a maximum delay of 10ms[34] and employ a self-trip function. Available technologies include a dedicated fibre optic cable or licenced radio link.

8.1.6 Loop automation schemes (I-CAIS)

Automatic feeder restoration schemes comprising of ACRs, known as Loop Automation Schemes, are commonly installed within the overhead distribution network. Automatic re-energisation of the feeder during this process opens the nearest upstream device (being either the feeder CB or ACR) with minimum

33 Is consistent with other SPS schemes within the TasNetworks transmission network.

34 TasNetworks transmission line protection maximum delay

delay following a power system fault and then attempts to automatically re-energise the tie ACR after a predefined disconnected time (dead time). Automatic reclosing can occur multiple times depending on the design of the Loop Automation Scheme.

If an EG is installed on a feeder within, or adjacent to, a Loop Automation Scheme there is the potential that the Loop Automation Scheme may automatically reconfigure the network and connect the generator to an alternative feeder that is not part of the I-CAIS. This operation may also result in the connection of an unsynchronised island to the national grid. To mitigate these risks Loop Automation Schemes shall be included in the island detection algorithm, where it is to operate to isolate the EG.

8.1.7 Transmission islanding events (I-CAIS)

The operation of transmission protection devices has the potential to island the entire substation that connects to the EG via the transmission network. If TasNetworks determines that the automatic operation of a device in the transmission network can result in the creation of a viable islanding condition, these identified devices shall be included in the I-CAIS.

The implementation of LLB on devices within the transmission network shall be reviewed by TasNetworks to ensure that they do not result in unacceptable operational restrictions.

8.1.7.1 Auto-Close Schemes (I-CAIS)

Bus coupler auto-close schemes are implemented in several substations within the Tasmanian electricity network. These schemes enable the substation to operate with the bus coupler in the open position to reduce downstream fault levels. If the supply to either substation bus is interrupted, the bus coupler will automatically close to restore supply to the affected bus.

If an EG is connected downstream of the affected bus, the supply interruption will result in the islanding of the EG. The subsequent auto-close operation has the potential to reconnect an unsynchronised island to the national grid. To prevent this, the bus coupler shall be included in the island detection algorithm, triggering the POC to trip when the supply is interrupted to the affected bus while the bus coupler is open and auto close is enabled.

LLB shall be installed to inhibit the auto-close operation if an island is present. However, implementing LLB on the bus coupler auto-close scheme would prevent the restoration of supply to customers on the entire bus, reducing the service provided to regulated customers. To mitigate this impact, LLB shall be implemented on the auto-close scheme by tripping the EG feeder CB before the automatic closure of the bus coupler. If the feeder CB trip is set to initiate a reclose, the LLB installed on the CB will prevent the connection of the unsynchronised island without affecting the service to regulated customers on adjacent feeders. This trip shall be directly implemented between the two devices, without routing through the island detection algorithm. The trip operation shall be alarmed at NOCS.

Before incorporating the auto-close scheme into the I-CAIS, TasNetworks Secondary designers shall review the auto-close scheme to determine whether it continues to be necessary for network operation or if it can be decommissioned as part of the EG connection.

8.1.8 Supervisory Control and Data Acquisition (I-CAIS)

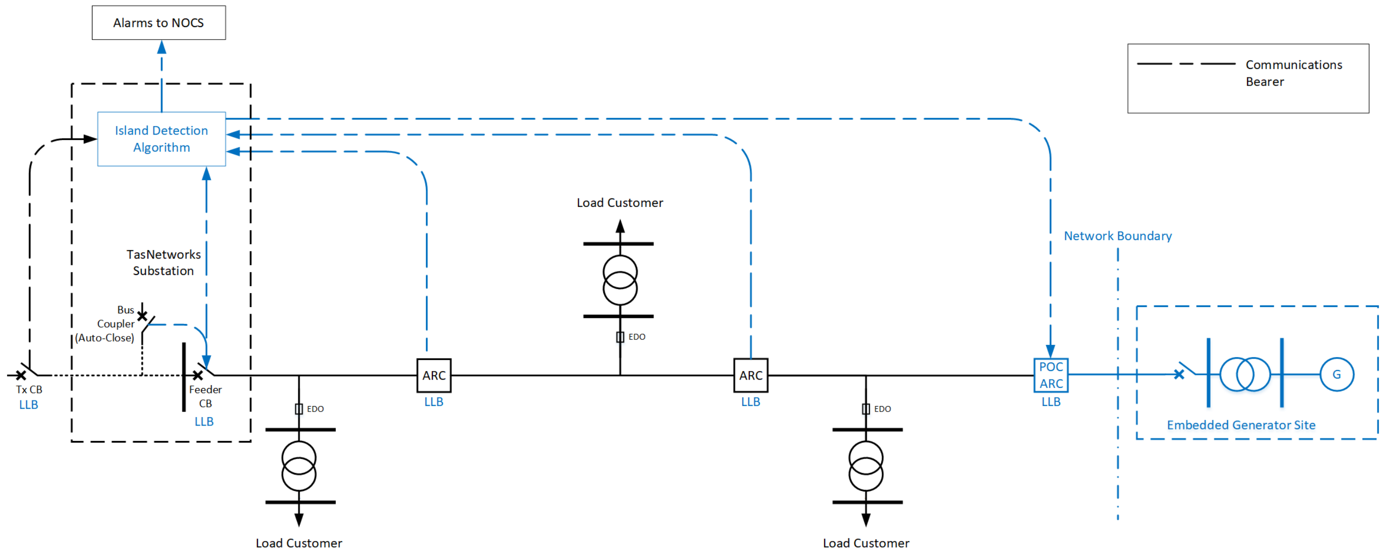
The health and status of all elements that form part of the island detection algorithm shall be monitored through the Supervisory Control and Data Acquisition (**SCADA**) and alarmed at NOCS.

Additional SCADA requirements are detailed in the TasNetworks LV/MV Embedded generation Technical Requirements.

8.1.9 Block diagram (I-CAIS)

The standard I-CAIS is presented in Figure 1, with network augmentations shown in blue.

Figure 1 I-CAIS Block Diagram[35]



8.2 Low reliability 4G Inter-trip CAIS (4G-CAIS)

TasNetworks recognizes that, for some proposed connections, the proponent may believe that implementing a high reliability communications bearer (Section 8.1.5) would impose a burden that is disproportionately high compared to the benefits gained. To support the connection of new generation into the Tasmanian Network, TasNetworks shall consider allowing the proponent to connect under a lesser standard, provided that the proponent can demonstrate that the SFAIRP process (Section 6) has been followed, and that all reasonably practicable precautions are in place to meet all duty holders due diligence requirements under Australian Law[36].

If the proponent can demonstrate to TasNetworks that the implementation of a high reliability communications bearer is not practicable, TasNetworks shall consider accepting the substitution of the high reliability communications bearer (Section 8.1.5) for a third party 4G communications bearer. In these cases, trip times will include the latency and reliability of the 4G network.

For TasNetworks to accept the use of a 'low reliability 4G Inter-trip CAIS' (4G-CAIS), the proponent, as a duty-holder, shall utilise the SFAIRP process (Section 6) to demonstrate that all reasonably practicable precautions are in place[37]. This requires identifying all islanding risks associated with the connection of their EG, identify all practicable precautions to address these risks, and show that a 4G-CAIS meets the reasonableness test according to Australian Law. This also requires that the proponent accepts all the risk of using 4G-CAIS in its operation and its assets.

This risk assessment shall address compounding of residual risks when using a 'low reliability 4G Inter-trip CAIS' (4G-CAIS), as the connection of EGs into the network increases over time. TasNetworks, shall only

35 Voltage sending LLB shown.

36 TasNetworks expects the SFAIRP risk assessment to be undertake by suitably qualified personnel experienced in undertaking SFAIRP risk assessments.

37 Any risk assessments submitted to TasNetworks must not contain any restrictions that would prevent the document being shared with third parties, i.e. future proponents.

accept residual risks that remain acceptable in a scenario of significant growth of EGs connecting to the network.

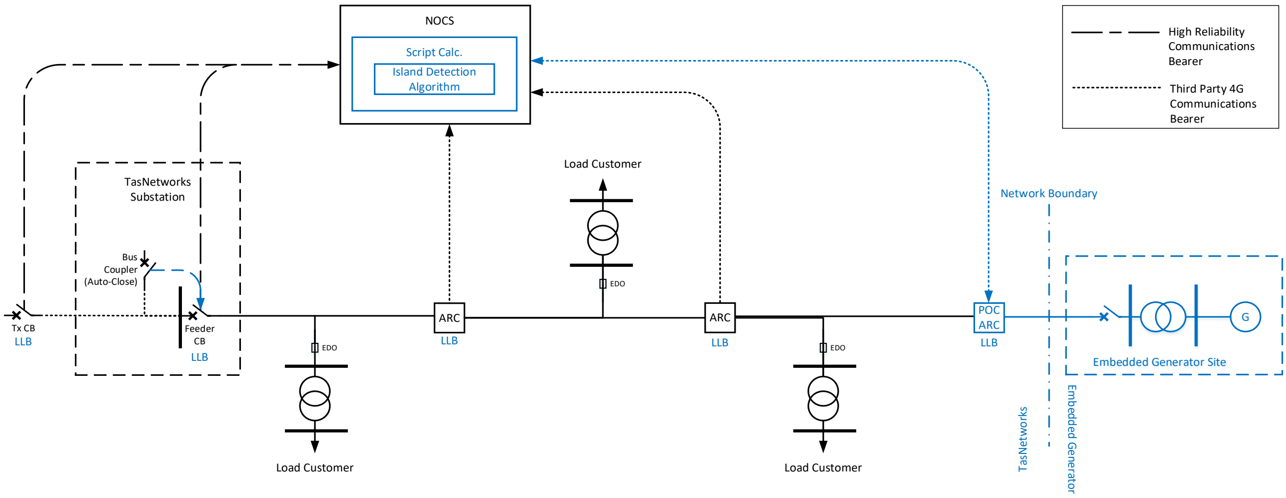
SFAIRP is an ongoing process which may require the implementation of additional measures at the proponent's expense if further risk mitigation measures become practicable throughout the life cycle of the 4G-CAIS.

The following sections outline the requirements for a 'low reliability 4G Inter-trip CAIS' (4G-CAIS).

8.2.1 Block diagram (4G-CAIS)

The standard low reliability 4G Inter-trip CAIS (4G-CAIS) block diagram is presented in Figure 2, with network augmentations shown in blue.

Figure 2 4G CAIS[38]



8.2.2 Communications networks in the Tasmanian power system

TasNetworks has established a highly reliable telecommunications network that support the SCADA and protection communications requirements to safely operate the Tasmanian Power System. This network ensures robust and secure communications between different elements of the transmission network and the TasNetworks Network Operations and Control System (NOCS).

In addition to the highly reliable telecommunications network, some telemetered ACRs deployed in the Tasmanian network leverage the availability of third-party 4G services for their SCADA communications. This integration of 4G technology provides an alternative means of communication, offering flexibility and broader coverage throughout the power system.

The use of a 4G network introduces inherent latency, which makes it not possible to accurately determine the time it takes to receive messages. This variability can result in message delays or failures due to network congestion. Environmental factors such as interference, low signal-to-noise ratio, and rain fade can further decrease the reliability of the signal.

TasNetworks considers a third-party 4G communications bearer to be of low reliability, susceptible to congestion delays and outages. Since there is no service level agreement available with the third-party provider, the service can be lost at any time, and the duration for service restoration is undefined. As a

[38] Voltage sending LLB shown.

result, TasNetworks has historically utilised third-party 4G communications primarily to improve service reliability for regulated customers and not for AIS purposes.

It is important to note that the level of service required for improved customer reliability is significantly lower than that necessary for a 4G-CAIS. Therefore, when assessing the reliability of the 4G-CAIS scheme, the proponent must consider the communications performance of the existing upstream automatic devices that need to be incorporated into the proponent's Island Detection Algorithm. Any necessary improvement works shall be undertaken at the expense of the customer.

8.2.3 Field device polling (4G-CAIS)

TasNetworks typically only polls field devices from NOCS every 5 minutes. The SCADA points upon which the island detection algorithm is reliant shall be configured to report the change of status instantaneously, instead of waiting to be polled. Device polling shall be increased, or a heartbeat shall be sent from the end device, to confirm communications availability.

8.2.4 Island detection algorithm (4G-CAIS)

The 4G-CAIS scheme relies on the NOCS for communication as the existing 4G communications bearers are routed through NOCS. Consequently, in the event of NOCS outages, the POC self-trip function would disconnect the generator from the network.

To implement the island detection algorithm, a NOCS script calculation can be utilized. However, it is important to note that the NOCS Script Calculations are run every 1 second, which introduces an additional delay to the scheme.

8.2.5 Trip Operations (4G-CAIS)

The 4G-CAIS has three distinct operations that may result in the disconnection of a generator. These operations are as follows:

1. Normal operation: Open the POC ACR after the formation of an Island;
2. Loss of communications type 1: Loss of communications between an upstream automatic device and the Island Detection Algorithm; and
3. Loss of communications type 2: Loss of communications between POC ARC and the Island Detection Algorithm.

Each trip operation, and the factors that affect the associated tripping times, are discussed in the following sections.

8.2.5.1 Normal operation (4G-CAIS)

During normal operation an island event will be asserted following the opening of an upstream automatic device. The following table outlines the subsequent sequence of events.

Table 4 – Normal operation – sequence of events

Step	Operation	Est time (seconds)
1.	Upstream automatic device opened resulting in an island	0

2.	Device state change sent over 4G transmitted.	<1s[39]
3.	Device state change received at NOCS from Field device	<2s (latency)
4.	NOCS script calculation executed	1s
5.	Island detected by anti-islanding algorithm and POC trip signal sent over (4G Front end processor delay)	<0.5s
6.	POC trip received over 4G	<2s (latency)
7.	POC trip	50 ms[40]
Total		< 6.55 seconds

Based on the inherent delays in the TasNetworks NOCS and the additional delays estimated for SCADA points to be sent and received over 4G, the POC ACR is expected to trip in less than 6.55 seconds of the island event. It is important to note that these estimates may vary in practice due to the non-deterministic nature of the system.

8.2.5.2 Loss of communications type 1 (4G-CAIS)

The loss of communications to an upstream automatic device, which forms part of a 4G-CAIS, will prevent the island detection algorithm from initiating the disconnection of the EG from the network. Therefore, it is necessary for the POC ACR to be tripped in the event, that any of these communication bearers are lost.

The island detection algorithm shall act to trip the POC ACR, after a 10-second[41] loss of communications to its upstream automatic devices. This loss of communications may be determined by either:

1. A single failed scan from NOCS, or a missed heartbeat from the end device, when polling every 10 seconds; or
2. Multiple consecutive failed scans, or missed heartbeats from the end device, resulting in a total loss of communications for continuous period of 10 seconds.

8.2.5.3 Loss of communications type 2 (4G-CAIS)

When there is a loss of communications between the POC ACR and the island detection algorithm, the island detection algorithm will be unable to actively initiate the disconnection of the EG from the network. Therefore, it shall trigger the internal trip of the POC ACR when this communications bearer is lost.

The feasibility of implementing this self-trip is constrained by the duration of NOCS rebuild outages. This limitation is discussed in the following sections.

8.2.5.3.1 NOCS Rebuilds (4G-CAIS)

The TasNetworks NOCS undergoes weekly and monthly rebuilds, during which it is temporarily taken out of service. As a result, the operation of the 4G-CAIS will be interrupted for up to 3 minutes during these rebuilds.

8.2.5.3.2 Failsafe operation (4G-CAIS)

TasNetworks has determined that reconnecting all EGs within the network automatically during NOCS rebuilds would impose an impracticable burden. Additionally, inhibiting or delaying the self-trip of the POC during NOCS rebuilds is also not feasible. Therefore, in the implementation of a 4G-CAIS, the self-trip times shall be set to 3 minutes. It's important to note that this trip time is not intended to compensate for the

39 requires unsolicited DNP enabled.

40 NOJA ACR operation time.

41 This figure must be confirmed by the SFAIRP assessment.

low reliability of service provided by a third-party 4G carrier. This self-trip timing shall be verified and confirmed for each installation.

To ensure the reliability of the 4G service utilised by the AIS, the AIS shall be **locked out of service** if the Island Detection Algorithm detects a loss of communications exceeding 10 seconds between the Island Detection Algorithm and the POC ACR. The generator shall not be allowed to reconnect until the proponent demonstrates to TasNetworks that the communications issue has been resolved and will not recur. TasNetworks is not responsible for any financial impact on the proponent during the resolution of communication issues to the generator.

8.2.6 Decreased service level (4G-CAIS)

It is important to emphasize that the deviations mentioned above will result in an inferior service provided to the EG and may lead to reduced network access for the generator. In addition to conducting the SFAIRP assessment, TasNetworks strongly recommends that the proponent performs an additional risk assessment to understand the potential impact of these deviations on their connection. The proponent **shall** ensure they are fully aware of the implications of these deviations and how they may affect their ability to export power to the network.

TasNetworks advises that the necessary 4G communications infrastructure be established as early as possible. This will enable the proponent to assess the performance level achieved through the available 4G communications for all sites with their generator island detection algorithm. In cases where there is poor 4G coverage at specific sites, TasNetworks shall require the proponent to conduct a 4G site test or set up semi-permanent 4G logging equipment to determine the reliability of the 4G service before approving the connection application. TasNetworks also recommends that the proponent shall have a contingency plan in place in case the 4G service degrades to a level that affects their ability to establish a connection.

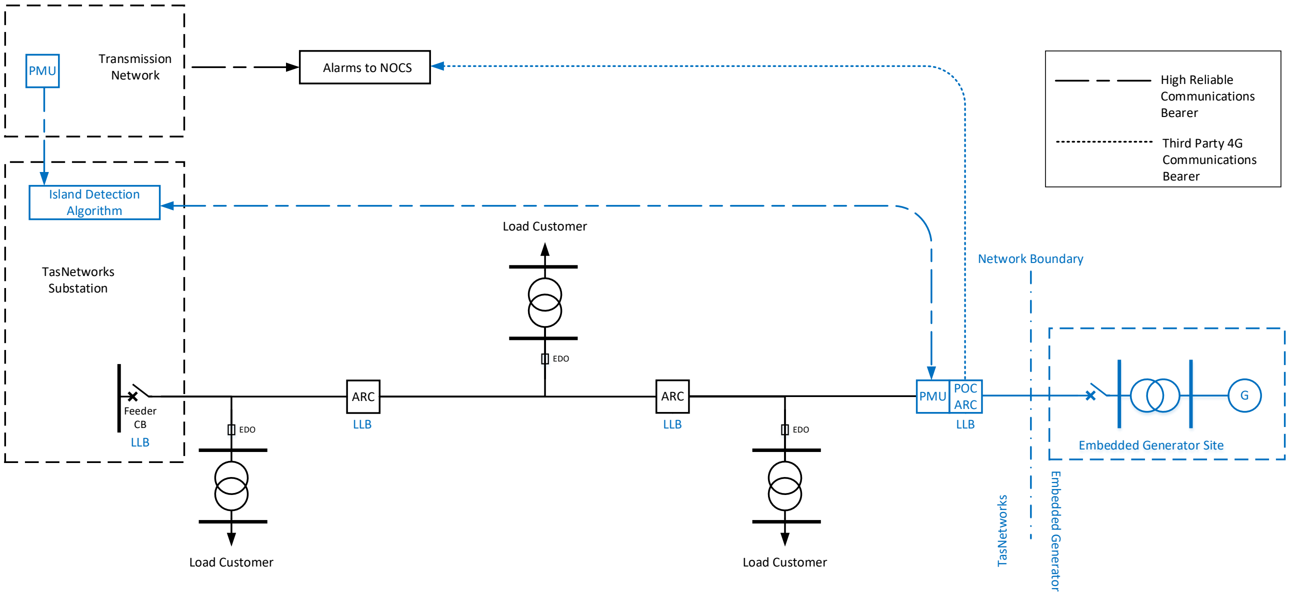
It should be noted that TasNetworks reserves the right to refuse the connection of an EG if the proponent fails to demonstrate that the 4G communications bearer is sufficiently reliable to support the 4G-CAIS.

8.3 Phasor Measurement Unit CAIS (PMU-CAIS)

A Phasor Measurement Unit CAIS (**PMU-CAIS**) utilises an island detection algorithm to compare synchro-phasor data measured at the POC with synchro-phasor data measured at a specific point in the transmission network. The point selected within the network must be in a location which cannot be islanded with the EG. By comparing the synchro-phasor data, the algorithm can determine if the two locations in the network are electrically connected. When an island condition is identified the island detection algorithm will initiate the trip of the POC ACR. Unlike the I-CAIS the PMU-CAIS does not require information about the state of the upstream automatic devices (Section 8.1.1) to detect an islanding condition. This simplifies the communications requirements, as only a single path is required to enable the operation of the anti-islanding algorithm.

A concept design of a PMU-CAIS is presented in Figure 3, with network augmentations shown in blue.

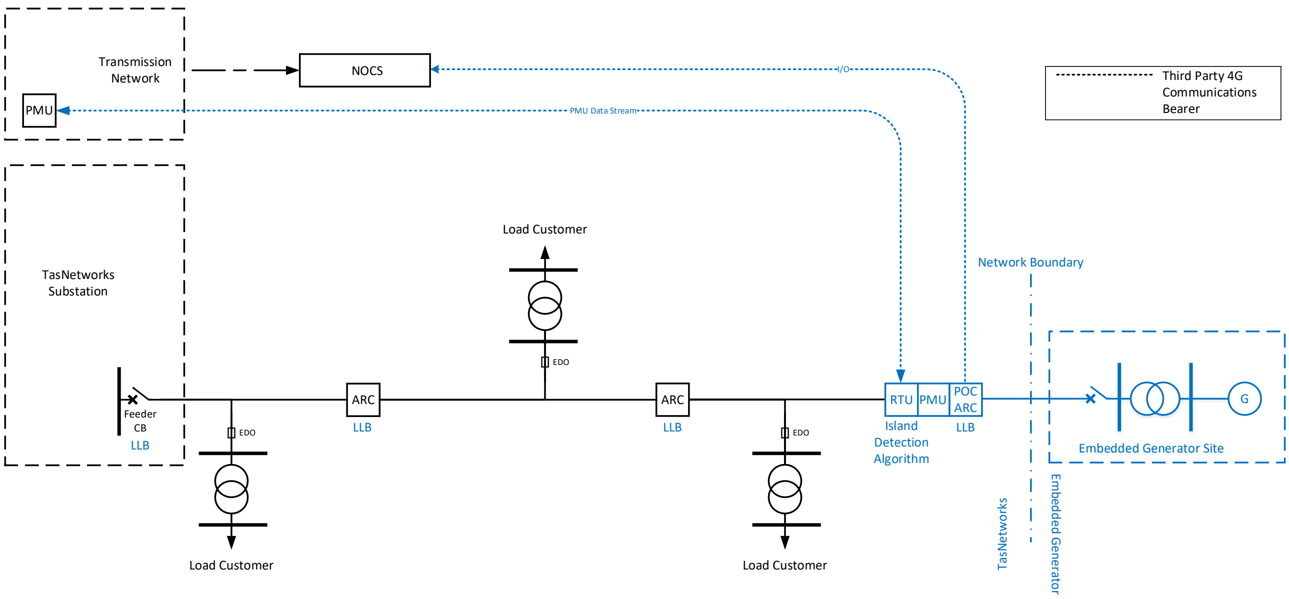
Figure 3 Network PMU-CAIS concept[42]



The PMU-CAIS utilises a highly reliable telecommunications bearer to transfer PMU data to the island detection algorithm and communication of the trip signal to the POC ACR. However, as detailed in section 8.2, where the installation of a high reliability communications bearer is not practicable (Section 6) TasNetworks shall consider to permit the substitution of the high reliability communications bearer with a third party 4G communications bearer provided that the proponent can demonstrate that the SFAIRP process has been followed.

Concept designs of a 4G-PMU-CAIS are presented in Figure 4, with network augmentations shown in blue.

Figure 4 4G Network PMU-CAIS concept[43]



It is important to note that, at the time of writing, TasNetworks has not yet implemented a PMU-CAIS in the distribution network. If selected by the proponent a PMU-CAIS can be considered as a 'proof of concept'

[42] Voltage sending LLB shown.
43 Voltage sending LLB shown.

trial prior to being approved for use as the EG CAIS. The proponent's design of the PMU-CAIS must also be supported with a SFAIRP risk assessment. If TasNetworks does not determine that the trial has been a success the proponent will be required to implement an inter-trip CAIS at their expense.

8.4 Redundancy

Redundancy of the AIS shall be achieved by the installation of duplicate passive anti-islanding protection within the POC ACR, and the EGs protection relays. Additionally, a CAIS shall be implemented, if required by TasNetworks, to contribute to the redundancy of the scheme.

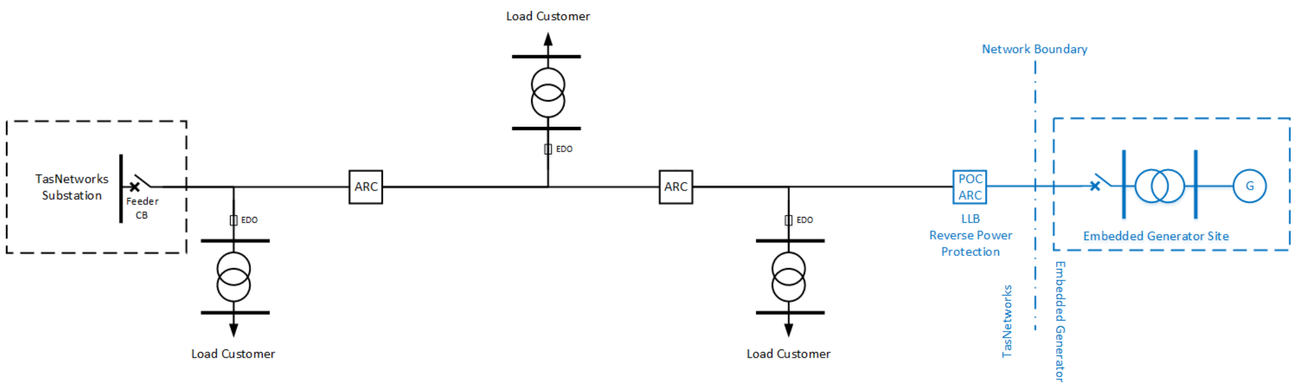
To enhance reliability, certain components of the CAIS, such as communications bearers, shall be duplicated as required and funded by the proponent.

9 Non-exporting EG AIS

For non-exporting EGs, where TasNetworks determines a viable islanding condition at the point of connection (POC), reverse power protection or a reliable run-back scheme on the TasNetworks side of the POC [44] shall be installed.

The standard Reverse Power AIS (**RP-AIS**) is presented in Figure 4, with network augmentations shown in blue. Where the POC is located at the feeder CB, TasNetworks shall consider to allow the installation of reverse power protection at the associated substation if feasible.

Figure 5 Reverse Power AIS



The activation of this protection function will result in the interruption of supply to customer loads connected downstream of the POC, in the private HV network. To avoid this scenario, the proponent shall install duplicate reverse power protection on their side of the POC that will trip the generator CB if reverse power is detected.

The design of the AIS shall ensure that network faults on neighbouring feeders do not cause a spurious reverse power protection trip. This protection shall include the following[45]:

- Adequate trip time delay. This parameter shall be assessed by TasNetworks Network Performance during the connection application. It is understood that 2 seconds will be appropriate in the majority of cases.

44 Reverse power protection must operate prior to any upstream auto-reclose operation. Reverse power protection is in addition to the Medium Voltage Embedded Generation Technical Requirements - Section 5.2.5.1 Passive anti-islanding protection.

45 Set to operate prior to the duplicated passive anti-islanding protection (0.85Un), if installed - Medium Voltage Embedded Generation Connection Technical Requirements - Table 7

- Under voltage blocking shall be set to 0.8Un, to inhibit the AIS scheme from tripping against faults on neighbouring feeders.

If multiple points of connection exist between the national grid and the customer's private network TasNetworks shall only permit one connection point to be closed at any time. This restriction is required to prevent power flow through the points of connection which would trip the reverse power protection. In this circumstance, a change of connection point would not be bump-less.

If bump-less transfer is required, the proponent shall propose a method where the TasNetworks Control Room can ensure that the EG is not connected to the national grid prior to the switching operation. If approved by the TasNetworks Secondary Systems team the proposed method shall allow reverse power protection to be temporally disabled during switching.

10 Low Voltage EG Connection

All EGs connected to the LV distribution network, determined by TasNetworks to be capable of forming a viable islanding condition, shall have an AIS installed. The standard approach is to have the generator connected to the MV network via a dedicated transformer allowing the AIS to be implemented at the MV network.

TasNetworks shall consider the installation of an alternative scheme at the LV level that is proposed by the client. However, any alternative scheme must ensure the equivalent functionality of the MV AIS is maintained.

TasNetworks shall take ownership of the POC equipment and the associated operation, and approval from TasNetworks shall be completed when maintenance of non-standard equipment is required.

11 Joint operating procedure

The Joint Operating Procedure (**JOP**) associated with the EG connection shall incorporate the requirements detailed in the following sections.

11.1 Normal operating state (JOP)

During the assessment of the EG connection, it will be assumed that the network is in its normal operating state. Whenever Network Operations necessitate reconfiguration of the network from its normal state, the EG shall be manually disconnected from the network by the TasNetworks Control Room.

11.2 Connection/reconnection (JOP)

The POC ACR shall be left open by the TasNetworks Control Room when the generator is not connected to the national grid. Prior to the planned connection, or disconnection of the generator, the EG operator shall seek approval from the TasNetworks Distribution Control Room.

Reconnection of an EG, following a trip from the CAIS, shall only occur after the TasNetworks Control Room has restored the network to its normal operating state, as network operations shall take precedence over EG reconnections.

When Control Room operators are available[46] the TasNetworks Control Room shall contact the EG operator to ensure that the EG is offline before closing the POC ACR. When the POC ACR is closed, permission shall be granted by the Control Room operator to reconnect the EG to the network. The EG operator shall inform the TasNetworks Control Room after the EG has been brought online and successfully synchronised to the network.

The reconnection process for an embedded generating system shall be agreed in the applicable JOP. The generator shall only be reconnected after the generator has been re-energised and has remained within the normal operational voltage and frequency limits for a period of at least five minutes. The final decision to reconnect the generator shall be at the discretion of TasNetworks, requiring approval by TasNetworks Operations. This process is intended to ensure that any reclose event has been successful and maximise the probability that the embedded generating system will remain in operation after reconnecting to the network.

If the proponent requires site supply to be maintained whilst the AIS is out of service[47], reverse power protection shall be installed at the POC (Section 9) and enabled when the AIS is out of service.

11.3 Live line work

TasNetworks routinely undertakes live line work in the distribution network. Prior to commencing this work, associated protection elements are set to a live line setting to protect TasNetworks personnel. The TasNetworks Control Room shall also disconnect the EG prior to undertaking live line work to protect TasNetworks personnel.

11.4 Network Reconfiguration

TasNetworks routinely reconfigures the network to maintain supply to customers. Where these configurations impact feeder, and consequently the AIS which connects the EG to the network, TasNetworks shall require the generator to be taken offline.

12 Connection capability report

As part of the EG's connection application, TasNetworks shall generate a Connection Capability Report. This report shall provide functional design information including the requirement for an AIS and the type of scheme needed to support the generator's connection. The report shall include the following:

- Identification of the required AIS type (Section 8), including:
    - Studies required to determine if a CAIS is necessary to disconnect an EG island sustained by a load/generation balance.
    - Identification of the location of upstream automatic devices (ACRs and CBs) in the distribution and transmission network that must be included in the island detection algorithm.
    - Identifies loop automation schemes that must be included in the island detection algorithm.

46 TasNetworks cannot provide a minimum time to reconnect an EG. Networks operations will take precedence over the reconnection of an EG.

47 For planned outage, supply from alternative feeder, etc.

    - Note if the proponent requires site supply to be maintained whilst the AIS is out of service (Section 11.2) and non-exporting AIS settings are to be provided.
    - Non-exporting AIS:
        - Provides settings for reverse power protection, specified by Network Performance
    - PMU-CAIS:
        - If the proponent has requested to trial a PMU-CAIS the locations of existing network PMUs, which can be utilised in the PMU-CAIS, should be noted. Network Performance to identify applicable PMUs.
        - Confirmation that there are no automatic devices in the transmission network that can island the EG, with the transmission network PMU, and prevent the implementation of a PMU-CAIS.
- Outage data that would affect the operation of the AIS must be provided, where applicable:
    - Outage data for the proposed connection feeder. i.e. 1 year of historical CB and ACB operations that would prevent the operation of a CAIS;
- Provides the draft Connection Capability Report to the Secondary Designers for review.
- Provides the final Connection Capability Report to internal stakeholders for their information:
    - NOCS Team Leader.
    - Real Time Operations Managers.
    - Secondary Systems Team Leader.

13 Preliminary Design information

If requested by the proponent TasNetworks shall provide preliminary design information for a 4G-CAIS. This information can be utilised by the proponent to assess the viability of the 4G-CAIS scheme, and can support a SFAIRP risk assessment:

- Any major work required to enable LLB on the upstream automatic devices, such as the installation of a VT on the feeder CB[48].
- Historical 4G orbit modem performance data, if available, for existing ACRs that are to form part of the CAIS[49];
- Desktop assessment of the 4G coverage at the proposed POC[50]. If the results of the desktop assessment indicate that 4G coverage may not be adequate the requirement for a 4G site test or establish semi-permanent 4G logging equipment will be noted.

14 Future Network augmentation

TasNetworks may at any time augment the electricity network to support the connection of new customers. This augmentation may have a material impact on the generators AIS. This can include the installation of additional ACRs that require inclusion in the AIS associated with an existing EG. These works shall be carried out at the cost of TasNetworks, will endeavour to provide communications to new ACRs so

48 With the assistance of the Secondary Systems team where required.

49 Sourced from the NOCS, with the assistance of the NOCS team.

50 Utilising coverage Optus and Telstra 4G coverage maps.

that they will not decrease the reliability of the CAIS. However, TasNetworks is not responsible for any decrease in service resulting from the installation of new network components in an existing AIS.

15 Roles and Responsibilities

The stakeholders that form part of an EG connection requiring an AIS are detailed below in Table 5:

Table 5 – Stakeholders

Stakeholders	Responsibilities
Customer Connection Services	• Manages customer connection application in the distribution network or to a dedicated zone substation feeder. • Development of the operation procedure related to the EG.
Network Planning	• Specifies if an Anti-Islanding Scheme (AIS) is required under this standard for the connection of a proposed embedded generator to manage risks introduced by the connection • Produces a Connection Capability Report for each EG connection application (Section 12). • Ensures that new devices added to the network do not impact existing AIS.
Network Performance	• Determines the requirement for anti-islanding to meet TasNetworks' system security, reliability obligations. • Ensures that the AIS detailed in this standard meets TasNetworks' system security, reliability obligations.
Asset Management Systems and Standards	• Maintenance of the Embedded Generation Anti-Islanding standard.
Design & Estimation	• Reviews the connection application report produced by Network Planning. This is to include endorsement of the automatic devices list or development of an updated list to allow Network Planning to revise the report. • Verifies that new devices added to the network do not impact existing AISs. • If requested provides the proponent with preliminary design information for a 4G-CAIS. • Produces an estimate for the TasNetworks to implement the CAIS. • Performs design work for the CAIS, outside of the NOCS. • Produces the associated 'Anti-Islanding Scheme (AIS) - Functional implementation'. • A review of the automatic protection schemes is to be undertaken to ensure that the AIS will prevent an automatic device re-closing onto an unsynchronised island. Specifically for the following: • If Interlocking LLB is chosen by the proponent, instead of voltage sensing (Section 4.3.1), ensure that the LLB signal is received at the automatic device prior to the automatic re-close dead time of each device.

Stakeholders	Responsibilities
	• If reverse power protection is implemented, ensure that it will operate to disconnect the generator prior to the automatic re-close dead time of each automatic device. • Maintenance of a design folder and standard design for standard AISs. • Support implementation of a maintenance plan to ensure the reliable operation of each AIS scheme in the network and ensure that tests are carried out as per the planned schedule. • Maintenance of a design folder and standard design for standard AISs.
Secondary Systems Assets (**P&C**)	• Provides technical support, review and advice on matters relating to protection and SCADA assets and settings. • Review of proponent's application for a 4G-CAIS, if applicable, and accepts a written risk assessment that the implementation of a I-CAIS is not practicable under SFAIRP. • Ensures that future changes to the network do not affect the SFAIRP assessment • Provides technical support to Design & Estimation to estimate the cost of installing a CAIS. • Implements a maintenance plan to ensure the reliable operation of each AIS scheme in the network and ensure that tests are carried out as per the planned schedule.
NOCS Team	• Maintenance of a design folder and standard design for the 4G-CAIS NOCS implementation and script calculation. • Produces the associated 'Special Protection Scheme (SPS)', from the 'Anti-Islanding Scheme (AIS) - Functional implementation', for the design of the island detection algorithms located in the NOCS (script calculations). • Implements the CAIS components within the NOCS. • Provides modem performance data when requested by the Design and Estimation Team.
Network Operations	• Approves the operation procedure related to the EG. • Responsible for manually disconnecting the EG from the network whenever the network is reconfigured from its normal operating state. • Ensures that the operation of the EG doesn't create a risk to TasNetworks field crew.

Figure 6 Workflow for EG connection assessment, AIS determination and design