Low Voltage Embedded Generation Network Access Standard

UE-ST-2008.2

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1. Introduction

This document provides the technical requirements for the equipment and installation of low voltage (LV) embedded generation (EG) connections to United Energy's (UE) low voltage distribution network. This document has been prepared based on present network conditions and is subject to change. This document complies with the ENA National Distributed Energy Resources (DER) Connection Guidelines for LV EG Connections, with the exception of UE specific requirement deviations presented in Appendix A: Deviations from the National DER Connection Guidelines.

This document shall be read in conjunction with UE-PR-2008 EG Customer Connection Procedure. UE-PR-2008 details the EG connection services offered and the application process.

1.1 Purpose of document

The purpose of this document is to provide proponents of LV EG connections information about their obligations for connection to and interfacing with the UE low voltage distribution network.

A LV EG connection type is defined in Table 1 and Table 2 provided:

a. it is intended to be connected to and is capable of operating in parallel with any part of the LV distribution network

b. it meets all other technical requirements set out in this document

c. a Certificate of Electrical Safety (CES) is issued for the installation and provided to UE

d. it consists of either Inverter Energy System (IES) or non-IES (synchronous or asynchronous LV EGs), and/or Energy Storage System (ESS) with a total system capacity shown in Table 1 and Table 2

1.1.1 LV EG IES Connection Limits

Single phase customers are not permitted to apply for negotiated connections. Negotiated connections apply only for IES installations greater than 30kVA. Please refer to UE-ST-2008.1 Basic Micro EG Network Access Standard.

Table 1: LV EG IES capacity and export limits[1]

Network Connection Type	Two Phase	Three Phase
Minimum total installed capacity (based on maximum continuous inverter rating)	> 30kVA	> 30kVA
Maximum total installed capacity (based on maximum continuous inverter rating)	Up to the maximum rating[2] of the main circuit breaker	Up to the maximum rating[2] of the main circuit breaker and total capacity of less than 5MVA[3]
Maximum export	10kW per phase	Up to the maximum rating[2] of the main circuit breaker and total capacity of less than 5MVA[3]

Notes:

1. Table 1 applies to LV EG IES that exceeds the 30kVA maximum total installed capacity requirement for Basic Micro EG connection. The capacity limits in Table 1 is the aggregate maximum continuous inverter rating installed behind the meter.
2. The maximum rating of the customer owned main circuit breaker and associated wiring is assumed to be appropriately sized to match the maximum thermal rating of upstream UE assets e.g. service cable/line and transformer.
3. To align with the maximum capacity stipulated in Chapter 5A of the National Electricity Rules, the total LV EG IES capacity can be up to less than 5MVA. However, the maximum total installed capacity is typically limited to 2MVA per transformer connection due to the standard 50kA LV short circuit fault rating for LV switchgear.
4. The above table is subject to technical requirements as set out in Section 5

1.1.2 LV non-IES EG Connection Limits

UE does not permit a non-IES installation to operate in parallel with the network for single phase and two phase connections.

Table 2: LV non-IES EG capacity and export limits[1, 2]

Network Connection Type	Three Phase
Maximum total installed capacity	Up to the maximum rating[3] of the main circuit breaker and total capacity of less than 5MVA[4]
Maximum export	Up to the maximum rating[3] of the main circuit breaker and total capacity of less than 5MVA[4]

Notes:

1. The above table is subject to technical requirements as set out in section 8.
2. Basic Micro EG Network Access Standard does not apply to LV non-IES EG.
3. The maximum rating of the customer owned main circuit breaker and associated wiring is assumed to be appropriately sized to match the maximum thermal rating of upstream UE assets e.g. service cable/line and transformer.
4. To align with the maximum capacity stipulated in Chapter 5A of the National Electricity Rules, the total LV EG IES capacity can be up to less than 5MVA. However, the maximum total installed capacity is typically limited to 2MVA per transformer connection due to the standard 50kA LV short circuit fault rating for LV switchgear.

1.1.3 Combined LV EG IES and Non-IES System

For LV EG systems consisting of both LV EG IES and LV non-IES EG, the system capacities and export shall satisfy the requirements of both Table 1 and Table 2. This means that only proponents with a three phase network connection are allowed to have installations consisting of both LV EG IES and LV non-IES EG.

1.2 Scope

This document applies to LV EG systems proposals for connection to the grid. It applies to both new connections of LV EG systems and modifications to existing LV EG systems.

This document sets out the common requirements for both LV EG IES and LV non-IES EG systems in sections 1 to 4. LV EG IES specific technical, testing and commissioning, and operation and maintenance requirements are set out in Part A of this document. LV non-IES EG specific technical, testing and commissioning, and operation and maintenance requirements are set out in Part B of this document.

It excludes the following:

a. EG units covered by UE's Basic Micro EG Network Access Standards (refer UE-ST-2008.1)

b. EG units covered by UE's HV EG Network Access Standards (refer UE-ST-2008.3)

c. Electric vehicles, unless the on-board battery storage system is capable of exporting to the network (in which case the requirements in this document shall apply)

d. DER systems that do not generate electricity, including demand response / demand management systems, unless they impact on the ability of the LV EG system to meet the technical requirements

1.3 Obligations

UE has developed this standard to meet its obligations to ensure the safe and reliable operation of the distribution system for operating personnel, proponents, customers and the general public.

The obligations of proponents are:

a. The obligation to comply with the technical requirements as well as relevant national standards, industry codes, legislation and regulations. In the event of inconsistency, legislation and regulations shall prevail, followed by the technical requirements, followed by national standards and industry codes

b. The obligation to not connect additional LV EG units, make modifications or install additional LV EG units, including ESS, without prior written agreement from UE

c. The obligation to comply with the UE's connection agreement

d. The obligation to meet the requirements in the design, installation, operation and maintenance of the LV EG system.

1.4 UE LV EG Assessment Considerations

The following high level factors are taken into consideration relative to the proposal at each stage of the Connection Enquiry and Application to Connect process:

- Network safety, security and stability
- Network infrastructure availability, capability and capacity to facilitate the proposal
- Any need to refer the proposal to AEMO or another DNSP potentially impacted by the proposal;
- Infrastructure and commercial demarcation and crossover, especially when multiple jurisdictions are involved
- Consideration for non-network support opportunities (especially in areas of network constraints identified under UE’s Distribution Annual Planning Report)
- Depending on the proposal, suitable communications infrastructure to facilitate technical as well as National Electricity Market (NEM) market control requirement (protection and or LV EG scheduling operation)
- Embedded generation network impact (and nearby proponents)
- Network and proposal interconnection protection
- Network infrastructure thermal capacity
- Network voltage control
- LV EG fault level contribution
- Power factor of LV EG IES
- Power quality of supply generated
- LV EG operations (modus operandi: renewables, base, peaking etc.)
- Network augmentation (i.e. infrastructure upgrade) likely to be required to facilitate the proposal and commercial model such as contestability, construction, ownership, the classification of services provided and associated cost
- Network scope of work delivery timeframe
- All other suitable considerations unique to the proposal
- Compliance to Victorian Service and Installation Rules
- Compliance to Victorian Electricity Distribution Code
- Compliance to Chapter 5/Chapter 5A National Electricity Rules
- Existing and in-progress EG applications at the relevant network location

2. Definitions and Abbreviations

2.1 Definitions[1]

LV embedded generation connection	*A connection between a distribution network and a retail proponent's premises for a micro embedded generating unit, for which an offer in accordance* to Chapter 5A of the National Electricity Rules
Central protection	Central protection is the protection contemplated by AS/NZS 4777 (grid connection of energy systems via inverters) installed to perform the functions of: coordinating multiple inverter energy system installations at one site, providing protection for the entire inverter energy system installation and islanding protection to the connected grid as well as preserving safety of grid personnel and the general public
Connection agreement	A legally binding document between UE and the proponent stipulating the commercial and technical terms of the LV EG connection.
Embedded generating unit	*A generating unit connected within a distribution network and not having direct access to the transmission network*
Embedded generating system	A system comprising of multiple embedded generating units
Distributed Energy Resources	Power generation or storage units that are connected directly to the distribution network
Generating unit	*The plant used in the production of electricity and all related equipment essential to its functioning as a single entity.*
Generation	*The production of electrical power by converting another form of energy in a generating unit*
Inverter energy system	A system comprising of one or more inverters together with one or more energy sources (which may include batteries for energy storage), and controls, which satisfies the requirements of AS/NZS 4777.1:2016 and AS/NZS 4777.2:2015.
Low voltage	The mains voltage as most commonly used in any given network by domestic and light industrial and commercial consumers (typically 230V)
High voltage	Any voltage greater than 1kV AC

[1] Definitions in italics are consistent with the definitions under the National Electricity Rules

Micro embedded generation connection	*Means a connection between an embedded generating unit and a distribution network of the kind contemplated by Australian Standard AS 4777 (Grid connection of energy systems via inverters) currently up to or equal to 200kVA*
Market generating unit	*A generating unit whose generation is not purchased in its entirety by a retailer (and receives payment for generation through the National Electricity Market or Wholesale Electricity Market)*
Proponent	A person proposing to become a LV EG (the relevant owner, operator or controller of the embedded generating unit (or their agent))
Service Cable/Line	The final span or section of UE low voltage aerial or underground network that is connected to the consumer's terminals.
Site generation limit	The generation threshold that the embedded generation system cannot exceed, measured downstream of the connection point
Small generation aggregator	*A person who has classified one or more small generating units as a market generating unit*
Small registered LV EG	*A LV EG who elects to register a LV EG with the Australian Energy Market Operator as a market generating unit who would otherwise be entitled to an exemption to register based on size*
Standard connection	*A connection service (other than a LV embedded generation connection service) for a particular class (or sub-class) of connection applicant and for which an Australian Energy Regulator approved offer in accordance to Chapter 5A of the National Electricity Rules*
Single Wire Earth Return	Parts of the UE electrical distribution network that use a single live high voltage conductor to supply single-phase or split-phase electric power with higher network impedances, and with distribution supplying low voltages to premises
Technical requirements document	The document produced by each Distribution Network Service Provider setting out their requirements for proponents to enable a grid connection, to which these guidelines apply (this document).

2.2 Abbreviations

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AS/NZS	A jointly developed Australian and New Zealand Standard
CBD	Central Business District
CEC	Clean Energy Council
DER	Distributed Energy Resources
DNSP	Distribution Network Service Provider
EG	Embedded Generation
ESS	Energy Storage System
HV	High Voltage
IEC	International Electrotechnical Commission
IES	Inverter Energy System
LV	Low Voltage
NCC	Network Control Center
NEM	National Electricity Market
NER	National Electricity Rules
NMI	National Metering Identifier
ROCOF	Rate of Change of Frequency
SCADA	Supervisory Control And Data Acquisition
SWER	Single Wire Earth Return

2.3 Terminology

The following terminology has been used in this document:

- The word “shall” indicates a mandatory requirement to comply with this document
- The word “may” indicates a recommendation that will not be mandatorily imposed on the proponent
- The word “should” indicates a requirement that may be mandatorily imposed on the proponent based on connection specific safety or operational requirements

2.3.1 Subcategories

This document applies to all the following subcategories of LV EG connections unless otherwise specified:

1. LV EG IES capacity > 30 kVA – Any LV EG system, that is not a Basic Micro LV EG system, with total system capacity as set out in Table 1 for two phase or three phase network connection, meeting all relevant technical requirements for LV EG connections set out in this technical requirement document. Further subcategorised by:
    a. Exporting
    b. Non-exporting
2. LV non-IES EG connection – Any LV EG system that is not an IES, with a total system capacity as set out in Table 2 for three phase network connections, meeting all relevant technical requirements for LV EG connections set out in this technical requirement document. Further subcategorised by:
    a. Exporting
    b. Non-exporting

Where:

1. Exporting systems shall be considered to be LV EG systems operating in parallel with the LV distribution network and exporting electricity either via partial-export or full-export into the LV distribution network, where:
    a. Partial-export LV EG systems limit the amount of export into the LV distribution network to an agreed export threshold defined in the connection agreement
    b. Full-export LV EG systems can export into the LV distribution network to the full LV EG nameplate capacity (full AC rating).
2. Non-exporting systems shall be considered to be LV EG systems operating in parallel with the LV distribution network that are not approved to and limited to ensure they cannot export electricity into the LV distribution network.

3. Relevant Rules, Regulations, Standards and Codes

3.1 Standards and Codes

This section lists all the Australian and international standards and industry codes which shall apply to the design, manufacture, installation, testing and commissioning, and operation and maintenance of all plant and equipment for LV EG connections to the UE LV distribution network. The latest version of the Australian and international standards and industry codes shall be used.

In the event of any inconsistency between Australian and international standards and industry codes and UE's technical requirements, UE technical requirements shall prevail.

Table 3: Applicable Standards and Codes

Standard	Title
AS/NZS 3000	Electrical installations (known as the Australian/ New Zealand Wiring Rules)
AS/NZS 3010	Electrical installations – Generating Sets
AS/NZS 3011	Electrical installations – Secondary batteries installed in buildings
AS/NZS 4777	Grid connection of energy systems via inverters (multiple parts)
AS/NZS 5033	Installation and safety requirements for photovoltaic (PV) arrays
AS/NZS IEC 60947.6-1	Low-voltage switchgear and control gear – Multiple function equipment - Automatic transfer switching equipment
AS 60034.1	Rotating electrical machines, Part 1: Rating and performance
AS 60034.12	Rotating electrical machines – Starting performance of single speed three phase cage induction motors
AS 60034.22	Rotating electrical machines, Part 22: AC LV EGs for reciprocating internal combustion (RIC) engine driven generating sets
SA/SNZ TR IEC 61000.3.14	Electromagnetic compatibility (EMC), Part 3.14: Limits — Assessment of emission limits for harmonics, inter harmonics, voltage fluctuations and unbalance for the connection of disturbing installations to LV power systems
SA/SNZ TR IEC 61000.3.15	Electromagnetic compatibility (EMC), Part 3.15: Limits — Assessment of low frequency electromagnetic immunity and emission requirements for dispersed generation systems in LV network
IEC 62116	Utility-interconnected photovoltaic inverters – Test procedure of islanding prevention measures
IEEE Standard 1547	IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
AS/NZS 1026	Electric Cables – Impregnated Paper Insulated – For Working Voltages up to and including 19/33 (36) kV
AS/NZS 1429.1	Electric Cables – Polymeric Insulated – For Working Voltages 1.9/3.3 (3.6) kV up to and including 19/33 (36) kV
AS/NZS 61000 series	Electromagnetic Compatibility
AS 60044.1	Instrument Transformers – Current Transformers
AS 60044.2	Instrument Transformers – Inductive Voltage Transformers
AS/NZS 60076.5	Power Transformers – Ability to Withstand Short Circuit
AS/NZS 60898.1	Electrical accessories – Circuit Breakers for overcurrent protection for household and similar installations, Part 1: Circuit Breakers for a.c. operation
AS/NZS IEC 60947	Low-voltage switchgear and control gear
IEC 60255	Measuring relays and protection equipment
UL 508	Standard for Industrial Control Equipment

3.2 Legislation and Regulation

This section lists all 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 LV EG connections to the distribution network. The latest version of the legislation and regulations shall be applicable.

In the event of any inconsistency between legislation and regulations and UE's technical requirements, the legislation and regulation shall prevail.

Table 4: Applicable Legislation and Regulations

Document Title	Description
National Electricity Rules Chapter 5A	Electricity Connection for Retail Customers
Electricity Distribution Code	Regulates the distribution of electricity, connections to distribution networks, and the transfer of electricity between distribution systems so that they are undertaken in a safe, efficient, and reliable manner
Electricity Industry Guideline 15 - Connection of Embedded Generation	Provides arrangements for connecting embedded generating units to distribution systems
Victorian Service and Installation Rules	Provides industry agreed technical requirements that meet all legislative and code requirements for the supply and metering related aspects of any connection to the Victorian electricity supply networks
Electrical Safety (Installation) Regulations	Provides details on regulatory obligations for electricity installation works in Victoria

4. Fees and Charges

Refer to UE's website[2] for type of connection fees applicable to LV EG connections and how these fees are determined. Where network augmentation works are required to accommodate the LV EG connection, a separate quote will be provided to the proponent. This is in addition to the application fees and charges.

[2] https://www.unitedenergy.com.au/industry/solar-energy/negotiated

Part A – IES Requirements

5. Technical Requirements for LV EG IES

This section details the technical requirements for LV EG IES connections.

5.1 Labelling and Signage

The labels and signs on the installation, including cables, shall be as per AS/NZS 4777.1:2016, AS/NZS 3000:2018 and AS/NZS 5033:2014. Site specific labelling for additional energy sources and operating procedure for the energy sources shall be installed at each isolation point that has a possibility of energy feedback from the IES.

5.2 Maximum System Capacity

Refer to Table 1 for details of maximum system capacity.

5.3 Generation Control

5.3.1 Export Limits at Connection Point

The maximum export limit of LV EG IES connections is as per Table 1.

The export limit where required will be negotiated with the proponent as part of the application process. The export limit imposed may be a “hard” or “soft” limit, consistent with the definitions within AS4777.1:2016.

The ability of the proponent’s LV EG system to export at the export limit is not guaranteed, but rather, it will depend upon network characteristics which change over time. UE reserves the right to revise the export limit of the proponent’s LV EG system if the system adversely affects the network safety and/or performance.

The following subsections outline possible reasons for export restrictions to the network.

5.3.1.1 Anti-Islanding

- IES systems with total capacity ≥ 30kVA but ≤ 500kVA – To ensure unintentional island does not form following an electricity distribution network outage, anti-islanding protection functions shall be implemented. Refer to Table 6 and Table 8 for detailed protection requirements.
- IES systems with total capacity > 500kVA - To ensure an unintentional island does not form following an electricity distribution network outage, IES systems will require reliable and immediate disconnection from the grid. Remote trip schemes are considered to be reliable and robust and this is UE’s preferred option for large IES systems. Alternative schemes or export restrictions may be considered on a case-by-case basis. However, for these alternative schemes, operation restrictions may apply and UE will not be able to guarantee the perpetuity of such schemes due to network changes over time. Refer to Section 5.7.3.5 for remote trip scheme requirements.

5.3.1.2 Network Voltage

UE has an obligation to maintain the network voltage in compliance to the Distribution Code. Introduction of LV EG IES to the network may impact the network voltage and push it beyond the limits of the Distribution Code. To reduce the impact on network voltage, UE may require LV EG IES to disable fixed power factor mode and enable the inverter’s volt response modes. Section 5.10.1 outlines UE requirements for IES volt response modes. Where the volt response modes do not adequately maintain the network voltage within the Distribution Code limits, the proponent may be required to pay for network augmentation. Where the proponent does not wish to pay to augment the network an export limit may be imposed as an alternative. Note that UE will not be able to guarantee the effectiveness of the voltage response modes in perpetuity for each proponent due to network changes over time.

5.3.1.3 Network Asset Constraints

Introduction of LV EG IES may result in the limits of network assets being exceeded (e.g. thermal limits etc.). Where the proponent does not wish to augment the network an export limit may be imposed as an alternative.

5.3.2 Site Generation Limit Downstream of Connection Point

The Victorian Service and Installation Rules stipulated that LV EG electrical characteristics shall be compatible with the relevant distributor's network, in this case UE's network. As such, the proponent shall ensure that the installation of the LV EG system does not cause the capability (e.g. thermal limits, harmonics etc.) of UE network assets at, or upstream of the network connection point to be exceeded.

5.4 Inverter Energy System

The IES shall comply with the following requirements:

1. IES shall be tested by an authorised testing laboratory and be certified as being compliant with AS/NZS 4777.2:2015 with an accreditation number
2. IES shall comprise of inverters that are registered with the CEC as approved network connected inverters
3. IES shall comprise of inverters that are tested by an authorised testing laboratory and certified as being compliant with IEC 62116 for active anti-islanding protection as per AS/NZS4777.2:2015
4. IES shall comprise of inverters installed in compliance with AS/NZS 4777.1:2016
5. IES shall comprise of inverters that have both volt-var and volt-watt response modes available.

All CEC approved inverters comply with the above requirements. Please refer to CEC website for a list of approved inverters.

5.5 Network Connection and Isolation

Network connection and isolation requirements shall be as per AS/NZS 4777.1:2016 and AS/NZS 3000:2018.

5.5.1 LV EG IES shared with multiple NMIs

For multiple occupancy land titles with a shared IES connection, the voltage and current inputs to the central protection device shall be measured at the point of common coupling of the installation as shown in Figure 1. This shall be in accordance with the Electricity Safety Act, Electricity Safety (Installations) Regulations and Victorian Service and Installation Rules. See section 5.7.3 for details on central protection.

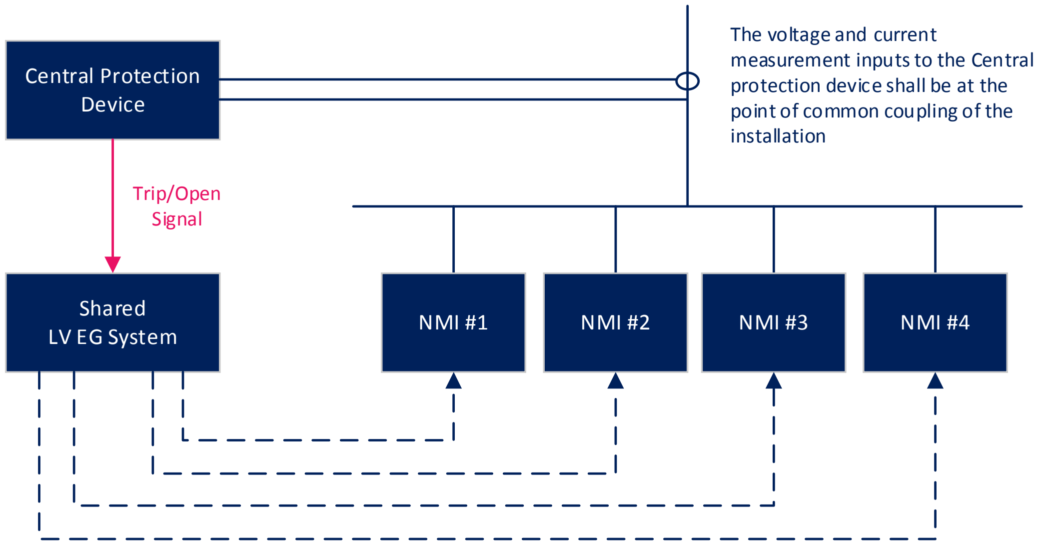

Figure 1: Shared LV EG System

5.5.2 LV EG IES located on different land title

A safety risk may be present in the event the owner of multiple land titles sells one of the land titles to another owner and retains the PV system connection as shown in Figure 2. A PV system located on another land title may reasonably be assumed to be **NOT** connected to the point of supply of the neighbouring land title. This may result in a safety incident due to unintentional incorrect isolation of the PV system while electrical works are carried out in the neighbouring land title. Hence, if the owner of the multiple land title sells one of the land titles, the owner of the land title with the PV system shall apply for a unique National Meter Identifier (NMI).

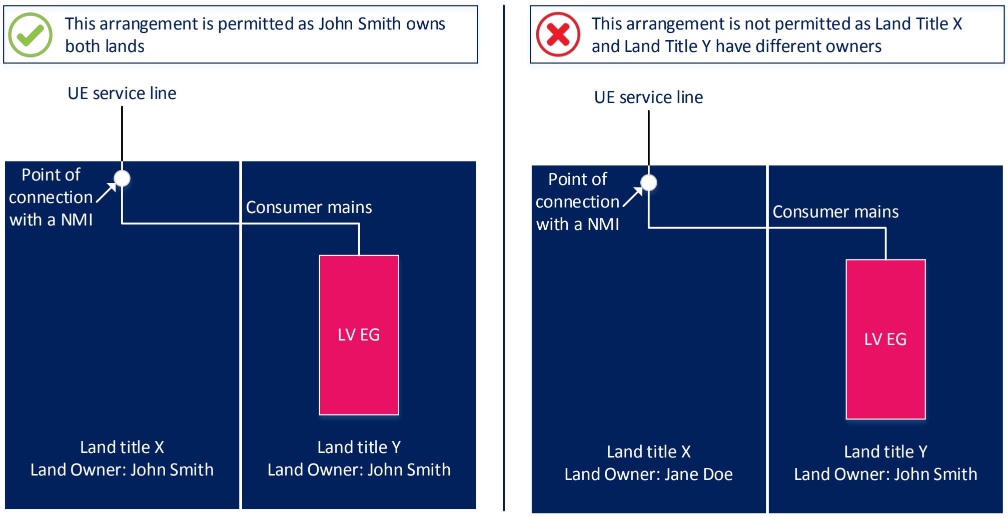

Figure 2: Multiple land titles

5.6 Earthing

The earthing requirements shall be:

1. For IES, earthing requirements shall be as per AS/NZS 4777.1:2016 and AS/NZS 3000:2018
2. For ESS, shall be as per AS/NZS 5139:2019 and AS/NZS 3000:2018.

5.7 Protection

The intention of this section is to ensure the safe and reliable operation of the distribution system for operating personnel, proponents, customer (i.e. electricity consumers) and the general public. The LV EG IES intending to connect to the network shall not adversely affect the operation and safety of other existing network users. UE may impose limitations and/or conditions of operation on the new LV EG IES connection in order to mitigate these issues.

Although AS/NZS 4777.1:2016 currently only applies to IES systems less than or equal to 200kVA, the protection requirements for all IES systems shall be in accordance to AS/NZS 4777 and as follows for each connection type:

Table 5: LV EG IES Protection Requirements

IES protection	Single Phase Connection	Two Phase Connection	Three Phase Connection
Inverter integrated protection according to AS/NZS 4777.2:2015[1]	Not Applicable See Section 1.1.1	Yes	Yes
Central protection		Yes	Yes

Note:

1. Where phase balance protection is not incorporated as part of the inverter protection, a separate phase balance protection device shall be installed. This function may be provided by the central protection device.

5.7.1 Overcurrent and Earth Fault Protection

The overcurrent and earth fault protection settings shall be site specific. Examples of site specific factors include circuit rating, loading, fault level, device grading etc. Operation of overcurrent/earth fault protection shall immediately trip a suitably fault rated circuit breaker.

5.7.2 Inverter Integrated Protection

AS/NZS 4777.2:2015 and AS/NZS 4777.1:2016 inverter protection settings for LV EG IES connections are tabulated below. Please note that the proponent is responsible for ensuring that these settings are suitable for their application. Where there is a need to deviate from the settings below, this shall be negotiated with UE as part of the application.

Table 6: Inverter Integrated Protection Settings

Protection function	Setting	Maximum disconnection time
Under voltage	180V	2s
Sustained over voltage (based on average value over a period of 10min)	258V	3s
Over voltage 1	260V	2s
Over voltage 2	265V	0.2s
Under frequency	47Hz	2s
Over frequency	52Hz	0.2s
Phase Balance Protection	21.7A between phases	30s
Minimum reconnection delay following a protection trip	60s	

5.7.3 Central Protection

Central protection requirements of AS/NZS 4777.1:2016 shall apply to LV EG IES connections as per Table 5. The central protection functions for each LV EG IES connection subcategory is shown in Table 7.

Table 7: Central protection requirements

Protection function	Exporting	Non-exporting
Network reverse power protection	-	-
IES circuit phase balance protection	-	-
Overcurrent and earth fault protection	-	-
Passive anti-islanding protection	✓	✓
Remote tripping (see section 5.3.1)	-	×
Symbols are used to denote protection requirements, where: ✓ Represents that the protection shall be required – Represents that the protection may be required × Represents that the protection shall not be required		

The central protection device shall be compliant with IEC 60255.

The central protection device shall implement various protection schemes and be designed such that:

- All protection elements initiate tripping of a suitably rated circuit breaker (tripping of CB isolates the IES); or

- Current based protection elements (e.g. overcurrent, earth fault) initiate tripping of a suitably rated circuit breaker while voltage based protection elements (e.g. over voltage, under voltage, over frequency, under frequency) initiate opening of a suitably rated contactor

For voltage-based protection elements, if the trip/open signal is not hard wired to the disconnection device (i.e. circuit breaker or contactor), a dedicated wireless trip scheme may be used. The trip/open signal shall be initiated by a protection grade device (IEC 60255 compliant). The communication equipment used to transmit and receive the trip/open signal shall be fit for purpose and compliant to AS/NZS IEC 60947 or equivalent. The receipt of the trip/open signal shall operate the disconnection device directly. This is illustrated in Figure 3 below:

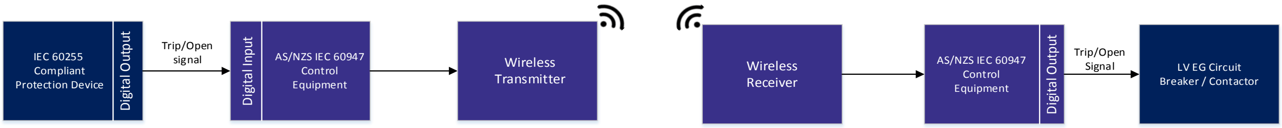

Figure 3: Typical Wireless Base Protection Trip Scheme

The protection scheme shall be fail safe such that in the event of any component failure (e.g. device fault, wiring fault, loss of aux supply, circuit breaker failure, wireless trip communications etc.), the LV EG IES shall be automatically disconnected from the network within 2s.

End to end supervision of the wireless communication shall be enabled and failure of the wireless communication shall disconnect the LV EG IES in less than the auto reclose dead time of the upstream UE feeder CB or ACR. At present, the auto reclose dead time on UE's network is 8s. The time delay for the supervision function shall be negotiated with UE as part of the application.

5.7.3.1 Network Reverse Power Protection

The reverse power protection is configured to look towards the network. The setting shall be set as per agreement with UE and use a maximum trip delay of 2s. Delays of greater than 2s shall be negotiated with UE.

5.7.3.2 Phase Balance Protection

Where phase balance protection is not incorporated as part of the inverter protection, this may be implemented via the central protection relay. As per AS4777.1:2016, the current unbalance between phases at the LV EG IES connection point caused by a LV EG IES (or multiple IES) shall not exceed 21.7A (5kVA at 230V) and shall trip the circuit breaker within a maximum of 30s if this limit is exceeded.

5.7.3.3 Passive Anti-islanding Protection

Voltage measurement for anti-islanding protection implemented within the central protection device shall be located upstream of both the LV EG connection and any power quality improvement devices (i.e. active filters etc.). The passive anti-islanding protection shall be as per Table 8. Active anti-islanding protection shall be as per AS/NZS 4777.2:2015.

Table 8: Passive anti-islanding protection

Protection function	Setting	Maximum disconnection time
Under voltage	180V	2s
Sustained over voltage (based on average value over a period of 10min)	255V	15s
Over voltage 1	260V	2s
Under frequency	47Hz	2s
Over frequency	52Hz	2s
ROCOF	3.0Hz/s	1s
Vector Shift	12°	0s

5.7.3.4 Reconnection Time Delay

The central protection is required to have a reconnection time delay of greater than 60s. In other words, once the protection has operated and tripped the main circuit breaker or contactor, the network parameters must be within the limits set out in Section 5.7.3.3 for at least 60s before the LV EG IES can reconnect with the network.

5.7.3.5 Remote Trip Scheme

The purpose of the remote trip scheme is to immediately and automatically transmit a trip command to the proponent's LV EG CB in response to a UE protection trip resulting in the loss of the relevant UE HV feeder. Figure 4 below illustrates a typical remote trip scheme.

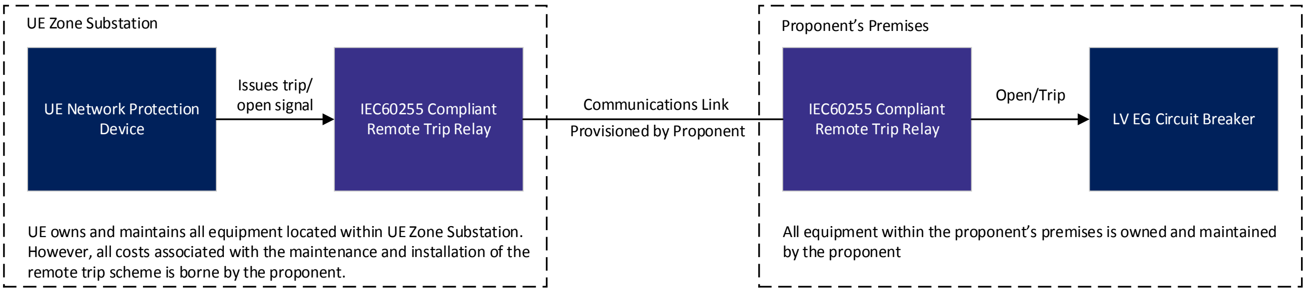

Figure 4: Typical Remote Trip Scheme

The minimum requirements for the proponent's remote trip scheme are as follows:

- Send a remote trip signal to the proponent's LV EG CB for any relevant UE protection operation, "loss of mains" network scenarios on the HV supply feeder including overcurrent, earth fault and sensitive earth fault protection.
- UE NCC operators shall have the facility to trip the proponent's LV EG CB via UE NCC SCADA and this trip shall be latched until it is reset by the NCC operator.
- Send a remote trip signal to the proponent's LV EG CB for any manual initiated CB open command on the HV supply feeder (both via UE operator on site at the supply zone substation or controller in the UE NCC).
- Tripping of the proponent's LV EG CB shall be completed within a maximum of 200ms from the time of the UE protection operation or manually initiated command.
- The scheme shall be configured so that the proponent's LV EG CB is automatically tripped in the event the integrity of the scheme is compromised, including equipment failure associated with the scheme. The proponent LV EG CB shall trip if the integrity of the scheme is not restored (e.g. equipment failure, loss of auxiliary supply) within 2s to ensure the scheme is fail safe.
- End to end supervision of the communication shall be enabled and failure of the connection shall disconnect the HV EG in less than the auto reclose dead time of the upstream UE isolation device. The time delay for the supervision function shall be negotiated with UE.
- At a minimum the following information shall be telemetered to the UE NCC via SCADA for each proponent's remote trip scheme:
  - Equipment fail alarm for both ends
  - Health of communications link
  - Remote trip received by proponent
  - Proponent LV EG CB fail to open (after receipt of remote trip signal)
  - Proponent LV EG CB status (open/closed)
  - Loss of mains (loss of network) protection operated

- Proponent generation (kW) with measurement accuracy within ±2%
- Proponent reactive power output (kvar) with measurement accuracy within ±2%
- Proponent net load (kW) with measurement accuracy within ±2%
- Proponent net reactive power consumption (kvar) with measurement accuracy within ±2%
- Additional voltage, current or power quality parameters such as harmonics, flicker, voltage dips and swells may be required. These will be negotiated as part of the application process.

5.7.3.6 Special Operational Conditions

The following LV EG protection is required for special UE network operational conditions:

- **Live line work by UE**

  When works are undertaken near or on live HV distribution feeders, UE enables a live line operating mode which disables automatic reclose and enables low set instantaneous overcurrent and earth fault protection. With live line mode enabled, grading may be compromised with downstream protection (including the protection associated with the LV non-IES EG installation). If the proponent wishes to operate their LV non-IES EG when live line mode is enabled, the LV non-IES EG protection will also need to act much more quickly to disconnect from the network for phase-phase faults on the HV feeder while live line sequence is enabled. As such, additional requirements may be required and shall be negotiated with UE as part of the application.

- **Total Fire Ban (TFB) Days**

  For LV EG installed in areas that may experience TFB restrictions, if the proponent chooses to operate their LV EG on TFB days, the LV EG will be required to disconnect instantaneously to avoid contribution to a fault. As such, additional requirements may be required and shall be negotiated with UE as part of the application.

5.7.4 Switchgear and control gear requirements

The switchgear and control gear associated with the LV EG IES connection shall be:

- Switchgear and Control gear – be fit for purpose and compliant with either AS or international standards (such as IEC 60947, UL 508 etc.).
- Switchgear – appropriate breaking and thermal capacities based on the fault level at the switchgear location. Refer to Figure 5 below (this is extracted from Table 5 of the Electricity Distribution Code) for the maximum LV fault level. Site specific fault level at UE transformer LV terminals can be obtained from UE.

Table 5

DISTRIBUTION SYSTEM FAULT LEVELS		
Voltage Level kV	**System Fault Level MVA**	**Short Circuit Level kA**
66	2500	21.9
22	500	13.1
11	350	18.4
6.6	250	21.9
<1	36	50.0

Figure 5: Fault levels extracted from the Electricity Distribution Code[3]

- LV EG isolation – All LV EG shall have a lockable LV EG isolating device owned and operable by the proponent.

3 https://www.esc.vic.gov.au/electricity-and-gas/codes-guidelines-and-policies/electricity-distribution-code

5.7.5 Interlocking

For cases where a LV non-IES EG exists downstream of the same point of connection as a LV EG IES, a break before make interlocking system shall be installed if no other control systems are in place. This is to ensure the safe parallel operation of the LV EG IES and the LV Non-IES EG. Where the following are implemented:

- Automatic transfer switch (ATS)

  The LV EG IES system shall be disconnected prior to the switching of the ATS. This interlocking system shall be fail safe.

- Manual transfer switch (MTS)

  Installations of manual transfer switches shall include suitable warning label instructions for the LV EG IES to be disconnected prior to the switching of the transfer switch.

When connecting an islanded LV EG system to the network, synchronisation check protection shall be implemented.

5.8 Operating Voltage and Frequency

The operating voltage and frequency range requirements can be found in Table 8.

Voltage rise requirement is as per Appendix F.2 (i) of AS/NZS 4777.1:2016 and is to be calculated at the point of supply. Figure 6 shows the application of the voltage rise requirements for a typical LV EG IES installation.

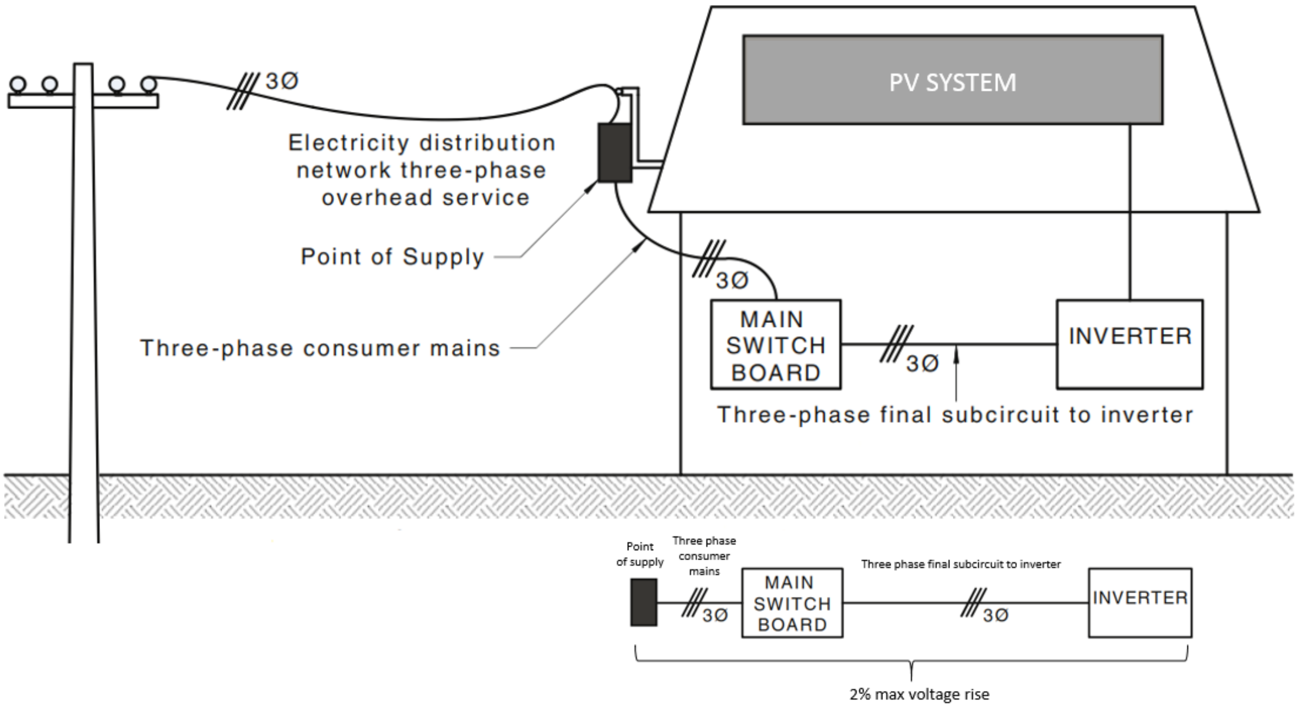

Figure 6: Application of voltage rise requirement for a typical LV EG IES installation

5.9 Metering

Metering shall be installed as per Victorian Service and Installation Rules[4].

[4] http://www.victoriansir.org.au/

5.10 Power Quality

LV EG IES shall comply with the applicable power quality requirements of the AS/NZS 61000 series as well as relevant Victorian regulations and licence conditions, including but not limited to:

- Network voltage control
- Voltage fluctuations
- Harmonics
- Voltage balance

5.10.1 IES Volt Response Modes

Inverters have power quality response capability to either maintain the power quality at the point of connection or provide support to the network. Inverters operating as LV EGs may be required to have volt response modes (volt-watt and/or volt-var response modes) enabled. This enables the inverter to respond to voltage changes at the inverter terminals without adversely affecting the voltage within an electrical installation. Where voltage response modes are not required, the inverters shall operate at unity power factor.

Volt-watt response mode

The volt-watt response mode varies the power output of the inverter in response to the voltage at its network side terminals. UE recommended response curve for the volt-watt response mode is defined by the volt response reference values and corresponding power levels in Table 9. Based on the network connection point, these settings will be negotiated as part of the application process.

Table 9: Volt-watt response maximum set point values for reference voltages (230V base voltage)

Reference	Volt reference value	Voltage (per unit)	P_{output}/P_{rated}
V1	207	0.90	100%
V2	220	0.96	100%
V3	253	1.10	100%
V4	259	1.13	20%

Volt-var response mode

The volt-var response mode varies the reactive power output of the inverter in response to the voltage at its network side terminals. UE recommended response curve for the volt-var response mode is defined by the volt response reference values and corresponding var levels in Table 10. Based on the network connection point, these settings will be negotiated as part of the application process.

Table 10: Volt-var response set point values for reference voltages (230V base voltage)

Reference	Volt reference value	Voltage (per unit)	var_{output}/VA_{rated}
V1	208	0.90	44% lead
V2	220	0.96	0%
V3	241	1.05	0%
V4	253	1.10	44% lag

Leading % var / VA level represents the inverter providing Vars to the grid whereas the lagging % var / VA level represents the inverter sinking vars from the network.

Energy storage charging response mode

Where an inverter is connected to an ESS, the inverter shall vary the power imported from the network to charge the energy storage device based on the voltage at its network side terminals. UE recommended response curve for this response mode is defined by the volt response reference values and corresponding power levels in Table 11. Based on the network connection point, these settings will be negotiated as part of the application process.

Table 11: Energy storage charging response mode (230V base voltage)

Reference	Volt reference value	Voltage (per unit)	P_{import}/P_{rated}
V1	207	0.90	0%
V2	220	0.96	100%
V3	250	1.09	100%
V4	265	1.15	100%

5.10.2 Power Factor Control

Volt-var response modes of the inverter system is utilised to reduce overvoltage conditions on the UE LV distribution network. However this will typically counter act the operation of power factor correction devices (e.g. capacitor banks) and hence measures shall be taken to disconnect these power factor correction devices at V3 setting of the volt-var response mode, which is typically ≥ 241V. See Section 5.10.1 for details on volt-var response mode.

5.10.3 Network Ancillary Services

AEMO is responsible for maintaining the network frequency close to 50Hz in accordance with the NEM frequency standards and for keeping the voltage within an acceptable range at particular nodes on the transmission network and for scheduling power flow between regions while maintaining power flows within the capability of plant. AEMO achieves these objectives by dispatching scheduled generation to match the load and via ancillary services.

Ancillary services can be one of the following:

- Frequency Control Ancillary Services (FCAS).
- Network Control Ancillary Services (NCAS).
- System Restart Ancillary Services (SRAS).

In practice FCAS and NCAS are offered by LV EGs by providing either real power or reactive power reserves that may be required in response to a network fluctuation, disturbance or event or based on load flows to provide local network support. Any LV EG has the option to provide ancillary services.

LV EG participating in network ancillary services (potentially IES with ESS) has the potential to rapidly change network load, resulting in significant voltage impact on the local network. Hence, the LV EG shall adopt necessary controls to prevent adverse impacts on the power quality at the point of connection while generating to provide ancillary services.

5.11 LV Embedded Networks with Embedded LV EG

A LV embedded network operator is exclusively responsible for the management of the embedded network including any LV EG within the embedded network. UE does not have a direct relationship with the LV EG and/or the proponent in this case. Hence, the LV embedded network operator shall make available to UE all necessary documentation to demonstrate compliance to this document and other applicable standards and regulations.

5.12 Communications Requirements for Monitoring Systems

For LV EG IES systems requiring remote trip schemes, the communication requirements are outlined in Section 5.7.3.4.

Communication requirements for alternate control schemes as mentioned in Section 5.3.1.1 shall be negotiated with UE as part of the application process.

For all other LV EG IES systems, UE does not require the proponent to provide any remote monitoring data to UE. However, proponents shall install remote monitoring of their LV EG IES systems to ensure that the proponent is promptly notified of issues on their LV EG IES systems. Remote monitoring of LV EG IES systems by the proponent may be achieved via use of IES manufacturer’s software applications.

5.13 Data and Information

5.13.1 Static Data and Information

The static data and information shall be provided by the proponent to UE as listed in Appendix D: Static Data and Information. UE will provide this data to AEMO's Distributed Energy Resource Register (DERR) on behalf of the proponent.

5.13.2 Dynamic Data and Information

For LV EG IES systems requiring remote trip schemes, the dynamic data requirements are outlined in section 5.7.3.5. Dynamic data requirements for LV EG IES systems implementing alternate control schemes as mentioned in Section 5.3.1.1. shall be negotiated with UE as part of the application process.

5.14 Cybersecurity

All devices and equipment settings associated with the LV EG system shall be secured against inadvertent or unauthorised tampering. Changes to the LV EG settings shall require the use of tools (e.g. special interface devices and passwords) and special instructions which shall not be provided to unauthorised personnel.

5.15 Technical Studies

Technical studies shall be completed as part of the connection application as per Table 12.

Table 12: Technical Studies Required for LV EG IES Connections

Technical Studies	LV EG IES
Voltage Rise Calculations	✓
Voltage Study	-
Power Flow Study	-
Fault Level Contribution Study	-
Protection Setting Report	✓
Power Quality Impact Study	-
Symbols are used to denote technical studies requirements, where: ✓ Represents that technical studies shall be required – Represents that technical studies may be required	

As part of the application process, UE shall provide the following network data to enable the proponent to complete the required technical studies:

- network fault levels up to the point of common coupling
- network protection information for UE assets (e.g. protection settings)
- network equipment information for UE assets (e.g. line and conductor ratings)

Where one or more of the technical studies does not meet the assessment criteria, UE shall provide the proponent feedback on components of the submission that require further work. The proponent has the option to discuss with UE:

- Alternative configurations of the LV EG IES systems
- Network augmentation (and associated cost of network augmentation)

5.15.1 Voltage Rise Calculations

Please refer to the UE's LV EG application form for additional information. This form can be found on UE's website[5].

5.15.2 Voltage Study, Power Flow and Power Quality Impact Studies

Please refer to the UE's LV EG application form for additional information. This form can be found on UE's website[8].

5.15.3 Fault Level and Protection Settings Report

A comprehensive protection study may be requested by UE for certain installations. Where this is required, the fault level contribution and protection settings shall be included in this study.

Where a comprehensive protection study is not required, the protection settings can be provided on either the Single Line Diagram or Protection Schematic.

Please refer to the UE's LV EG application form for additional information. This form can be found on UE's website[8].

[5] https://www.unitedenergy.com.au/industry/solar-energy/negotiated

6. Testing and Commissioning for LV EG IES

Testing and commissioning of the LV EG IES installation shall be undertaken by the proponent in accordance with AS/NZS 4777.1:2016 (where applicable), AS/NZS 3000:2018 and AS/NZS 5033:2014, the CEC approved test regime, the equipment manufacturer's specifications and to the technical requirements stipulated in this document, in order to demonstrate that the installed LV EG IES system meets the requirements of the connection agreement.

Note these tests shall be installation tests and not type tests of the equipment. Equipment type tests shall be as per IEC 62116. All CEC approved inverters are typed tested to IEC 62116.

In addition, the following requirements for network connection of LV EG IES systems shall be met:

1. Testing and commissioning plan shall be produced by the proponent. At a minimum, the plan shall cover all the requirements outlined in the LV IES Commissioning Form (see Appendix D: Static Data and Information). Table 13 below details the required test reports and documentations to be submitted to UE. This plan shall be prepared before any testing and commissioning work commences.
2. The results of all testing and commissioning activities (per the plan) shall be thoroughly documented
3. Testing and commissioning acceptance shall be signed off by a suitably qualified and authorised person
4. Testing and commissioning acceptance may require UE to carry out witnessing at the proponent's expense

Table 13: Testing and Commissioning Requirements for LV EG IES Connections

Testing and commissioning submission	LV EG IES	
	Exporting	Non-exporting
Protection settings and performance[1]	✓	✓
Power quality settings and performance	–	–
Export limits settings and performance	–	✓
Communications performance for monitoring system[2]	✓	✓
Shutdown Procedures	–	–
Confirmation that a site operation procedure and maintenance plan is available to the proponent	✓	✓
Confirm system is as per specifications	✓	✓
Confirm SLD is located on site	✓	✓
As-built documentation and drawings	✓	✓
Certificate of Electrical Safety (CES)	✓	✓
UE LV EG Commissioning Form (see Appendix D)	✓	✓
Symbols are used to denote testing and commissioning requirements, where: ✓ Represents that testing and commissioning shall be required – Represents that testing and commissioning may be required		

Notes:

1. Protection Settings and Performance

The LV EG IES central protection relay shall be tested by secondary injection. All necessary functional tests shall be carried out to prove that the protection and control schemes operate as per the design.

2. Communications performance for monitoring system

Where remote tripping is required, full end-to-end testing of the remote trip scheme is required.

7. Operations and Maintenance

The operation and maintenance requirements for LV EG IES connections to the UE network, includes:

1. The LV EG IES system shall be operated and maintained by the proponent to ensure compliance with their connection agreement and all legislation, codes, and/or other regulatory instruments at all times
2. Confirmation that maintenance of the LV EG IES system has been completed shall be submitted to UE by the proponent at a specified interval as agreed with UE

The following documentation is to be kept at the LV EG IES installation in compliance with relevant codes and is to be readily accessible by UE's representatives and other authorised parties:

- A single line diagram showing all electrical metering points, protection functions and zones of coverage.
- A record of all approved protection settings.
- A copy of the approved operating procedures.
- Maintenance plan and all subsequent maintenance records.

In addition, the proponent shall:

1. Maintain and operate the LV EG IES installation in a safe condition
2. Ensure that any changes to the LV EG IES installation are performed by an electrician lawfully permitted to do the work and that the proponent holds a Certificate of Electrical Safety (CES) issued in respect of any of the changes
3. Seek UE approval prior to altering the connection in terms of an addition, upgrade, extension, expansion, augmentation or any other kind of alteration, including any changes to firmware and protection functions or settings.

If any breach of this technical standard is suspected, UE may undertake an investigation. If the investigation reveals a breach, the proponent shall be required to rectify this breach and pay UE for the costs associated with the investigation and associated works undertaken by UE.

Part B – Non-IES requirements

8. Technical Requirements for LV non-IES EG

This section details the technical requirements for LV non-IES EG connections.

8.1 Labelling and Signage

The labels and signs on the installation, including cables, shall be as per AS/NZS 3000:2018. Site specific labelling for additional energy sources and operating procedure for the energy sources shall be installed at each isolation point that has a possibility of energy feedback from the LV non-IES EG.

8.2 Maximum System Capacity

Refer to Table 2 for details of maximum system capacity.

8.3 Generation Control

8.3.1 Export Constraints at Connection Point

The maximum export limit of LV non-IES EG connections is as per Table 2.

The export constraints where required will be negotiated with the proponent as part of the application process.

The ability of the proponent's LV EG system to export is not guaranteed, but rather, it will depend upon network characteristics which change over time. UE reserves the right to revise the export constraints of the proponent's LV EG system if the system adversely affects the network safety and/or performance.

The following subsections outlines possible reasons for export or minimum import restrictions to the network.

8.3.1.1 Anti-Islanding

- LV non-IES EG systems with total capacity < 1000kVA – To ensure an unintentional island does not form following an electricity distribution network outage, LV non-IES EG shall incorporate anti-islanding protection functions such as ROCOF, vector shift etc. to reliably and automatically disconnect from the network. Refer to Table 17 for detailed protection requirements. If there are insufficient load on the network to implement a reliable ROCOF and vector shift setting, minimum import may be considered or alternatively remote trip scheme may be required.
- LV non-IES EG systems with total capacity ≥ 1000kVA – To ensure an unintentional island does not form following an electricity distribution network outage, LV non-IES EG systems will require reliable and immediate disconnection from the network. Reliable schemes such as a remote trip scheme between the UE network and the LV non-IES EG shall be installed. Alternatively, minimum import depending on the connection point will avoid the requirement for such schemes. Refer to Section 8.6.2.3 for remote trip scheme requirements.

8.3.1.2 Network Voltage

UE has an obligation to maintain the network voltage in compliance to the Distribution Code. Introduction of LV non-IES EG to the network may impact the network voltage and push it beyond the limits of the Distribution Code. To reduce the impact on network voltage, UE requires all LV non-IES EG to enable voltage response modes as per Section 8.11.1. Where the voltage response modes do not adequately maintain the network voltage within the Distribution Code limits, the proponent may be required to pay for network augmentation. Where the proponent does not wish to pay to augment the network an export limit may be imposed as an alternative. Note that UE will not be able to guarantee the effectiveness of the voltage response modes in perpetuity for each proponent due to network changes over time.

8.3.1.3 Network Asset Constraints

Introduction of LV EG IES may result in the limits of network assets being exceeded (e.g. thermal limits etc.). Where the proponent does not wish to augment the network an export limit may be imposed as an alternative.

8.3.2 Site Generation Limit Downstream of Connection Point

The Victorian Service and Installation Rules stipulated that LV EG electrical characteristics shall be compatible with the relevant distributor's network, in this case UE's network. As such, the proponent shall ensure that the installation of the LV EG system does not cause the capability (e.g. thermal limits, harmonics etc.) of UE network assets at, or upstream of the network connection point to be exceeded.

8.4 Network Connection and Isolation

Network connection and isolation requirements shall be as per AS/NZS 3000:2018.

8.4.1 LV non-IES EG shared with multiple NMIs

For multiple occupancy land titles with a shared LV EG connection, the voltage and current inputs to the protection device shall be measured at the point of common coupling of the installation as shown in Figure 7. This shall be in accordance with the Electricity Safety Act, Electricity Safety (Installations) Regulations and Victorian Service and Installation Rules. See Section 8.6.2 for details on protection device requirements.

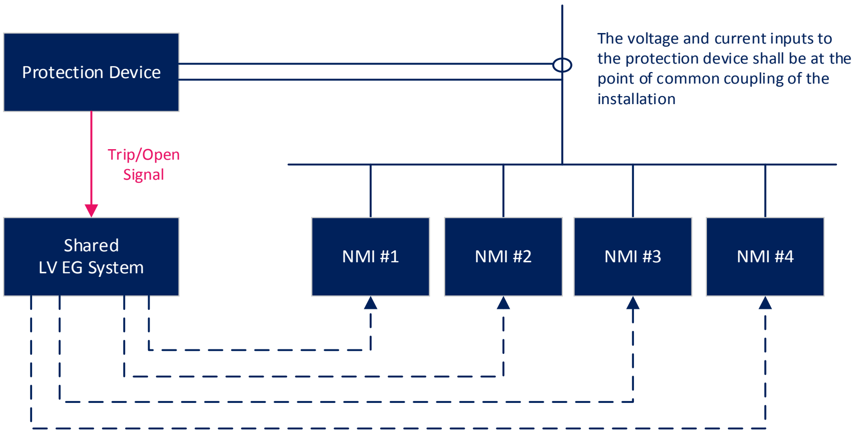

Figure 7 Shared LV EG System

8.4.2 LV non-IES EG located on different land title

A safety risk may be present in the event the owner of multiple land titles sells one of the land title to another owner and retains the LV EG system connection as shown in Figure 8. A LV EG system located on another land title may reasonably be assumed to be NOT connected to the point of supply of the neighbouring land title. This may result in a safety incident due to unintentional incorrect isolation of the LV EG system while electrical works are carried out in the neighbouring land title. Hence, if the owner of the multiple land title sells one of the land title, the owner of the land title with the LV EG system shall apply for a unique National Meter Identifier (NMI).

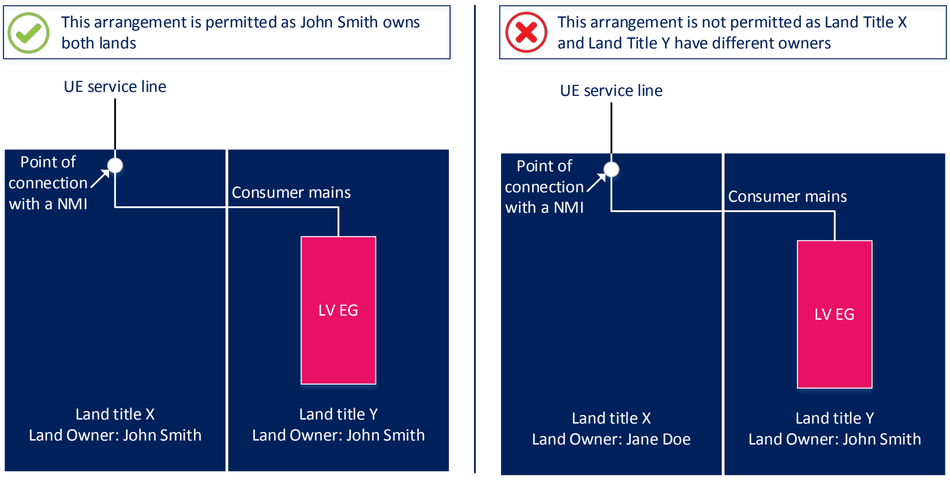

Figure 8: Multiple land titles under the same owner

8.5 Earthing

The earthing requirements for the LV non-IES EG system shall be in accordance with AS/NZS 3000:2018 and AS/NZS 3010:2017. The earthing system for the LV non-IES EG system must provide satisfactory earthing independent of UE's earthing system.

LV non-IES EG can contribute to network phase to ground fault levels. Hence, a review of its earth grid design and associated protection is required to ensure safety criteria (i.e. safe potential step and touch voltages) are not exceeded. Potential step and touch voltages are correlated with protection fault clearing time.

If a LV non-IES EG is designed to operate in island mode to supply a local load at the same premise (i.e. a backup electrical supply in the event of a loss of supply from the network), it shall have a local earthing system that can provide satisfactory earthing without relying on UE's earthing system. This is necessary because during a network supply outage, the neutral and or the MEN connection of the distribution network may be disconnected. An example of this is illustrated in Figure 9.

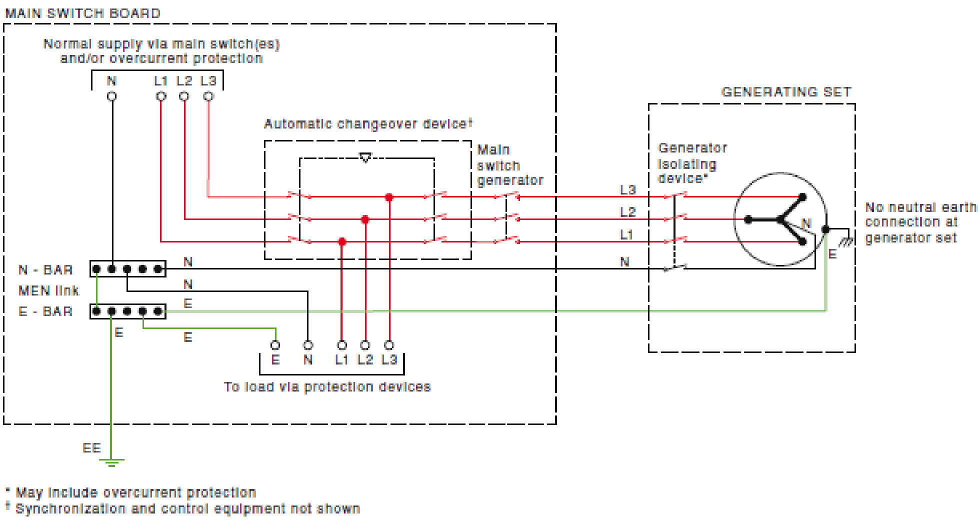

Figure 9 Example of earthing configuration

The LV non-IES EG neutral (i.e. star connected three phase winding) shall be earthed. The LV non-IES EG neutral(s) shall be bonded to earth at a single point – the multiple earth neutral point. ATS or MTS changeover shall not switch the incoming neutral to the MEN switchboard (as illustrated above).

For detailed earthing configurations for LV non-IES EG please refer to AS3000:2018 Section 7.3.8.

8.6 Protection

The intention of this section is to ensure the safe and reliable operation of UE's network for operating personnel, proponents and the general public. The LV non-IES EG intending to connect to the network shall not adversely affect the operation and safety of other existing network users. UE may impose limitations and/or conditions of operation on the new LV non-IES EG connection in order to mitigate these issues.

Table 14: Protection requirements for LV non-IES EG

LV EG protection	Three Phase Connection
LV EG integrated protection	Yes
Backup protection	Yes – exemption from backup protection is subject to negotiation with UE on a case by case basis

8.6.1 LV non-IES EG Integrated Protection

LV non-IES EG integrated protection refers to protection configured directly on the non-IES EG. For example, for a diesel generator, this is the protection directly programmed on the diesel generator controller. Table 15 below indicates UE preferred protection settings. Any deviations will need to be negotiated with UE during the application process.

Table 15: LV EG integrated protection requirements

Protection function	Setting	Maximum disconnection time
Under voltage	180V	2s
Over voltage 1	260V	2s
Over voltage 2	265V	0.2s
Under frequency	47Hz	2s
Over frequency	52Hz	0.2s
ROCOF	Calculated based on LV non-IES EG inertia and characteristics	≥ 0.2s
Vector Shift		Instantaneous
Reverse power towards LV EG	Typically 5% of LV non-IES EG power rating	To be determined by proponent
Synchronisation Check	• $\Delta\varphi$ < ±15°; to be negotiated with UE • Frequency and voltage deviation limits to be negotiated with UE	To be calculated based on manufacturer's specifications and synchronising method
Reconnection Time Delay	> 60s	

8.6.2 Backup Protection

Backup protection shall be required for all LV non-IES EG connections that has a total capacity greater than 30kVA. For LV non-IES EG connections with a total capacity of less than 30kVA, backup protection shall be required when:

- the integrated protection does not comply with IEC 60255, and/or
- secondary injection testing of the integrated protection is not possible

The backup protection relay shall be compliant with IEC 60255. It shall trip a circuit breaker for all current-based and voltage-based faults.

Where the protection scheme consists of a battery backup or UPS DC supply with adequate alarm and monitoring, failsafe wiring for the trip circuit may not be required. Otherwise, failsafe wiring is required for the trip circuit in the event of auxiliary supply failure to ensure that the LV non-IES EG disconnects within a maximum time of 2s.

In the event of the backup protection relay failure, the protection scheme shall disconnect the LV non-IES EG within a maximum of 2s. Where duplicated protection schemes have been implemented, this may not be required and will be assessed as part of the application process.

Trip signal shall be hard wired to the relevant circuit breaker. Where this is not possible and a wireless scheme is required, this shall be negotiated with UE as part of the application process. The proposed wireless scheme will be assessed based on the following:

- necessity for a wireless scheme
- dependability
- compliance of proposed equipment
- speed of operation
- failsafe functionality

Table 16 below indicates UE preferred protection functions for the backup protection relay.

Table 16: LV non-IES EG backup protection requirements

Backup protection function	Comments
Current based protection (Overcurrent and Earth Fault)	Required to disconnect LV non-IES EG for faults within the proponent's site and for faults on the network. See Section 8.6.2.1 for more details.
Current unbalance protection e.g. negative sequence current protection	Current in each phase shall not deviate from the average of the three phase currents by more than 5% for periods greater than 2 minutes.
Passive anti-islanding protection	Refer to Section 8.6.2.2
Synchronisation check	• $\Delta\varphi$ < ±15°; to be negotiated with UE based on manufacturer specifications • Frequency and voltage deviation limits to be negotiated with UE • Time delay to be calculated based on manufacturer's specifications and synchronising method
Power export protection	This is site specific and shall be negotiated with UE based on network constraints with a maximum trip delay of 2s.
Remote Tripping	This is site specific and shall be negotiated with UE based on network constraints. Refer to Section 8.6.2.3 for remote trip scheme requirements.
Reconnection Time Delay	The backup protection is required to have a reconnection time delay of greater than 60s post voltage-based protection reset (e.g. under voltage, over voltage etc.). In other words, once the protection has operated and tripped the relevant circuit breaker or contactor, the network parameters must be within the limits set out in Table 17 for at least 60s before the LV non-IES EG can reconnect with the network. For LV non-IES EG systems greater than 1MVA, the proponent shall contact NCC prior to reconnecting the HV non-IES EG system to the network.

8.6.2.1 Current based protection

The fault clearance time for a solid phase-to-phase or phase-to-ground short circuit at the network connection point must be less than 150ms. Where this fault clearance time cannot be achieved, the proponent should consult with UE to determine the maximum permissible fault clearance time to be adopted.

For an LV non-IES EG installation that is not supplied from a UE service fuse, it is necessary to undertake a grading study and to grade with the upstream network protection where possible. If the immediate upstream network protection device is a circuit breaker, the minimum grading margin shall be 0.3s.

8.6.2.2 Passive Anti-Islanding Protection

Voltage sensing for anti-islanding protection of the LV non-IES EG shall be connected at point of connection which is upstream of both the LV non-IES EG connection and any power quality improvement devices (i.e. active filters etc.).

Table 17 below indicates UE preferred anti-islanding protection settings.

Table 17 may not apply to LV non-IES EG that provides network services/ancillary services, which may operate with wider protection settings while supplemented with a reliable anti-islanding protection (e.g. remote trip scheme with UE). Any deviations shall be negotiated with UE during the application process.

Table 17: LV non-IES EG anti-islanding protection requirements

Protection function	Setting	Maximum disconnection time
Under voltage (V<)	180V	2s
Over voltage 1 (V>)	260V	2s
Over voltage 2 (V>>)	265V	0.2s
Under frequency (F<)	47Hz	2s
Over frequency (F>)	52Hz	0.2s
ROCOF[1]	Calculated based on LV EG inertia and characteristics	Decided based on ROCOF setting
Vector Shift[1]		Instantaneous

Note:

1. The suitability of ROCOF and Vector Shift for anti-islanding protection of the non-IES LV EG is summarised in Table 18. The suitability of ROCOF and Vector Shift for anti-islanding protection depends on the loading on the UE HV supply feeder. As the feeder loading may vary with time, the effectiveness of ROCOF and vector shift may be compromised. Hence, the proponent shall undertake periodic review of ROCOF and vector shift at an agreed interval with UE. The proponent will be required to modify the design of their LV EG installation if the anti-islanding protection is found to be inadequate.

Table 18: Suitability of ROCOF and vector shift for non-IES LV EG

Type of LV EG	Suitability of ROCOF and Vector Shift for Passive Anti-Islanding
Synchronous generator with capacity < 1000kVA	If the generator output is more than 80% of the minimum load on the HV feeder protection zone and network sectionalisation, the LV non-IES EG shall have a dedicated remote trip scheme between the feeder circuit breaker and/or ACR and the LV non-IES EG's circuit breaker. Refer to Section 8.6.2.3 for remote trip scheme requirements.
Asynchronous generator	An induction machine draws reactive energy for excitation from the electricity network and therefore cannot sustain operation and island. It is noted however that asynchronous LV non-IES EGs may self-excite from power factor correction capacitors and/or adjacent capacitance within the electricity network. For large LV non-IES EGs, studies will need to be undertaken to confirm that the output from such a LV non-IES EG will decay rapidly when network connection is lost. Anti-islanding protection in the form of ROCOF and voltage vector shift protection must be installed regardless of the outcome of such studies.

8.6.2.3 Remote Trip Scheme

The purpose of the remote trip scheme is to immediately and automatically transmit a trip command to the proponent's LV EG CB in response to a UE protection trip resulting in the loss of the relevant UE HV feeder. Figure 10 below illustrates a typical remote trip scheme.

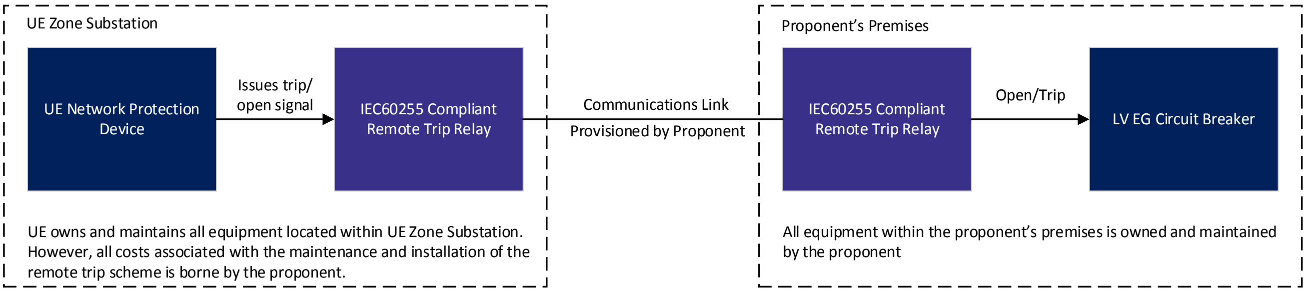

Figure 10: Typical Remote Trip Scheme

The minimum requirements for the proponent's remote trip scheme are as follows:

- Send a remote trip signal to the proponent's LV EG CB for any relevant UE protection operation, "loss of mains" network scenarios on the HV supply feeder including overcurrent, earth fault and sensitive earth fault protection.
- UE NCC operators shall have the facility to trip the proponent's LV EG CB via UE NCC SCADA and this trip shall be latched until it is reset by the NCC operator.
- Send a remote trip signal to the proponent's LV EG CB for any manual initiated CB open command on the HV supply feeder (both via UE operator on site at the supply zone substation or controller in the UE NCC).
- Tripping of the proponent's LV EG CB shall be completed within a maximum of 200ms from the time of the UE protection operation or manually initiated command.
- The scheme shall be configured so that the proponent's LV EG CB is automatically tripped in the event the integrity of the scheme is compromised, including equipment failure associated with the scheme. The proponent LV EG CB shall trip if the integrity of the scheme is not restored (e.g. loss of communications, equipment failure) within 4s to ensure the scheme is fail safe.
- End to end supervision of the communication shall be enabled and failure of the connection shall disconnect the HV EG in less than the auto reclose dead time of the upstream UE isolation device. The time delay for the supervision function shall be negotiated with UE.
- At a minimum the following information shall be telemetered to the UE NCC via SCADA for each proponent remote trip scheme:
  - Equipment fail alarm for both ends
  - Health of communications link
  - Remote trip received by proponent
  - Proponent LV EG CB fail to open (after receipt of remote trip signal)
  - Proponent LV EG CB status (open/closed)
  - Loss of mains (loss of network) protection operated
  - Proponent generation (kW) with measurement accuracy within ±2%
  - Proponent reactive power output (kvar) with measurement accuracy within ±2%
  - Proponent net load (kW) with measurement accuracy within ±2%

- Proponent net reactive power consumption (kvar) with measurement accuracy within ±2%
- Additional voltage, current or power quality parameters such as harmonics, flicker, voltage dips and swells may be required. These will be negotiated as part of the application process.

8.6.3 Special Operational Conditions

The following LV EG protection is required for special UE network operational conditions:

- **Live line work by UE**

  When works are undertaken near or on live HV distribution feeders, UE enables a live line operating mode which disables automatic reclose and enables low set instantaneous overcurrent and earth fault protection. With live line mode enabled, grading may be compromised with downstream protection (including the protection associated with the LV non-IES EG installation). If the proponent wishes to operate their LV non-IES EG when live line mode is enabled, the LV non-IES EG protection will also need to act much more quickly to disconnect from the network for phase-phase faults on the HV feeder while live line sequence is enabled. As such, additional requirements may be required and shall be negotiated with UE as part of the application.

- **Total Fire Ban (TFB) Days**

  For LV EG installed in areas that may experience TFB restrictions, if the proponent chooses to operate their LV EG on TFB days, the LV EG will be required to disconnect instantaneously to avoid contribution to a fault. As such, additional requirements may be required and shall be negotiated with UE as part of the application.

- **Short term parallel**

  UE requires the same analysis for both short term paralleling with the UE network as it does for continuous parallel operation of a LV EG. This is because the consequences of mal-operation are the same for short term parallel operation as with continuous operation. LV EG shall include a backup system to automatically disconnect the LV EG during a short term parallel in the event of a failure paralleling control scheme (i.e. extended parallel protection). LV EG will require protection as per above Table 16 if the extended parallel protection exceed 100ms to disconnect the LV EG.

- **Portable LV EG parallel operation**

  It is necessary to have critical protection and control systems as part of the permanent installation. See sections 8.6.1 and 8.6.2 for the required protection.

8.7 Switchgear and control gear requirements

The switchgear and control gear associated with the LV non-IES EG connection shall be:

- Circuit Breakers and Control Gear – be fit for purpose and compliant with either AS or international standards (such as IEC 60947, AS 3947.2, UL 508 etc.)
- Switchgear – appropriate breaking and thermal capacities based on the fault level at the switchgear location. Refer to Figure 11 (extracted from Table 5 of the Electricity Distribution Code) for the maximum LV fault level. Site specific fault level at UE transformer LV terminals can be obtained from UE.

Table 5

DISTRIBUTION SYSTEM FAULT LEVELS		
Voltage Level kV	**System Fault Level MVA**	**Short Circuit Level kA**
66	2500	21.9
22	500	13.1
11	350	18.4
6.6	250	21.9
<1	36	50.0

Figure 11: Fault levels extracted from the Electricity Distribution Code[6]

- LV EG isolation – All LV EGs must have a lockable LV EG isolating device owned and operable by the proponent.

8.8 Interlocking

For cases where another LV EG exists downstream of the same point of connection as a LV non-IES EG, a break before make interlocking system shall be installed where no control systems are in place to ensure the safe parallel operation of the LV non-IES EG and the LV EG. Where the following are implemented:

- Automatic transfer switch (ATS)

  The LV non-IES EG system shall be disconnected prior to the switching of the ATS. This interlocking system shall be fail safe.

- Manual transfer switch (MTS)

  Installations of manual transfer switches shall include suitable warning label instructions for the LV non-IES EG to be disconnected prior to the switching of the transfer switch.

- When connecting an islanded LV non-IES EG system to the network, synchronisation check protection shall be implemented.

8.9 Operating Voltage and Frequency

The operating voltage and frequency range requirements can be found in Table 15.

Voltage rise introduced by the LV EG shall not exceed 2%. This is the voltage rise at the LV EG terminals with respect to the voltage at the point of supply.

8.10 Metering

Metering shall be installed as per Victorian Service and Installation Rules.

8.11 Power Quality

LV non-IES EG have power quality response capability to either maintain the power quality at the point of connection or provide support to the network. LV non-IES EG shall comply with the applicable power quality requirements of the AS/NZS 61000 series as well as relevant Victoria regulations (e.g. Victorian Distribution Code) and licence conditions, including but not limited to:

- Network voltage control
- Voltage fluctuations
- Harmonics
- Voltage balance

8.11.1 LV Non-IES Voltage Response Modes

LV non-IES EG can be configured with either of the following modes:

- Fixed power factor control mode
- Voltage control mode
- Reactive control mode

[6] https://www.esc.vic.gov.au/electricity-and-gas/codes-guidelines-and-policies/electricity-distribution-code

The voltage response mode configured for LV non-IES EG shall be negotiated with UE as part of the application process as it is dependent on network characteristics at the point of connection.

8.11.2 Network Ancillary Services

AEMO is responsible for maintaining the network frequency close to 50Hz in accordance with the NEM frequency standards and for keeping the voltage within an acceptable range at particular nodes on the transmission network and for scheduling power flow between regions while maintaining power flows within the capability of plant. AEMO achieves these objectives by dispatching scheduled generation to match the load and via ancillary services.

Ancillary services can be one of the following:

- Frequency Control Ancillary Services (FCAS)
- Network Control Ancillary Services (NCAS)
- System Restart Ancillary Services (SRAS)

In practice FCAS and NCAS are offered by LV EGs by providing either real power or reactive power reserves that may be required in response to a network fluctuation, disturbance or event or based on load flows to provide local network support. Any LV EG has the option to provide ancillary services.

LV non-IES EG participating in network ancillary services has the potential to rapidly change network load, resulting in significant voltage impact on the local network. Hence, the LV non-IES EG shall adopt necessary controls to prevent adverse impacts on the power quality at the point of connection while generating to provide ancillary services.

8.12 LV Embedded Networks with Embedded LV EG

LV embedded network operator is exclusively responsible for the management of the embedded network including any LV EG within the embedded network as UE does not have direct relationship with the LV EG and/or the proponent. Hence, the LV embedded network operator shall have all materials which demonstrates compliance to this document and other applicable standards and regulations.

8.13 Communications Systems

For LV non-IES EG systems requiring remote trip schemes, the communication requirements are outlined in Section 8.6.2.3.

For all other LV non-IES EG systems, UE does not require the proponent to provide any remote monitoring data to UE. However, proponents shall install remote monitoring of their LV non-IES EG systems to ensure that the proponent is promptly notified of issues with their LV non-IES EG systems. Remote monitoring of LV non-IES EG systems by the proponent may be achieved via use of the LV non-IES EG manufacturer's software applications.

8.14 Data and Information

8.14.1 Static Data and Information

The static data and information shall be provided by the proponent to UE as listed in Appendix D: Static Data and Information. UE will provide this data to AEMO's Distributed Energy Resource Register (DERR) on behalf of the proponent.

8.14.2 Dynamic Data and Information

For LV non-IES EG systems requiring remote trip schemes, the dynamic data requirements are outlined in Section 8.6.2.3.

8.15 Cybersecurity

The LV EG settings shall be secured against inadvertent or unauthorised tampering. Changes to the LV EG settings shall require the use of tools (e.g. special interface devices and passwords) and special instructions not provided to unauthorised personnel.

8.16 Technical Studies

Table 19 below details the technical studies that shall be completed as part of the connection application:

Table 19: Technical Studies Required for LV non-IES EG Connections

Technical Studies	LV non-IES EG
Voltage Rise	✓
Voltage Study	–
Power Flow Study	–
Fault Level Contribution Study	–
Protection Settings Report	✓
Power Quality Impact	–
Symbols are used to denote technical studies requirements, where: ✓ Represents that technical studies shall be required – Represents that technical studies may be required	

As part of the application process, UE shall provide the proponent with the following for the proponent to complete the required technical studies:

- network fault level studies up to UE's transformers' LV terminals
- network protection information for UE assets (e.g. protection settings)
- network equipment information for UE assets

Where one or more of the technical studies does not meet assessment criteria, UE shall provide the proponent feedback on components of the submission that has not satisfied the assessment requirements of network connection. The proponent has the option to discuss with UE:

- Alternative configurations of the LV non-IES EG systems
- Network augmentation (and associated cost of network augmentation)

8.16.1 Voltage Rise Calculations

Please refer to UE's LV EG application form for additional information. This form can be found on UE's website[7].

8.16.2 Voltage Study, Power Flow and Power Quality Impact Studies

Please refer to UE's LV EG application form for additional information. This form can be found on UE's website[7].

8.16.3 Fault Level and Protection Settings Report

A comprehensive protection study may be requested by UE for certain installations. Where this is required, the fault level contribution and protection settings shall be included in this study.

Where a comprehensive protection study is not required, the protection settings can be provided on either the Single Line Diagram or Protection Schematic.

Please refer to UE's LV EG application form for additional information. This form can be found on UE's website[7].

[7] https://www.unitedenergy.com.au/industry/solar-energy/negotiated

9. Testing and Commissioning for LV non-IES EG

Testing and commissioning of the LV non-IES EG installation shall be undertaken in accordance with AS/NZS 3000:2018, AS/NZS 3010:2017, the equipment manufacturer's specifications and to the technical requirements stipulated in this document, in order to demonstrate that the installed LV non-IES EG system meets the requirements of the connection agreement.

Note these tests shall be installation tests and not type tests of the equipment.

In addition, the testing and commission requirements for grid connection of the LV non-IES EG system are:

1. Testing and commissioning plans shall be produced by the proponent.
2. Testing and commissioning acceptance shall be signed off by a suitably qualified person
3. Testing and commissioning acceptance may require UE to carry out witnessing at the proponent's expense

Table 20: Testing and Commissioning Requirements for LV non-IES EG Connections

Testing and commissioning submission	LV non-IES EG	
	Exporting	Non-exporting
Protection settings and performance[1]	✓	✓
Power quality settings and performance[2]	–	–
Export limits settings and performance	–	✓
Communications performance for monitoring system[3]	✓	✓
Shutdown Procedures	–	–
Confirmation that a site operation procedure and maintenance plan is available to the proponent	✓	✓
Confirm system is as per specifications	✓	✓
Confirm SLD is located on site	✓	✓
As-built Documentation and Drawings	✓	✓
Certificate of Electrical Safety (CES)	✓	✓
UE LV EG Commissioning Form (see Appendix D)	✓	✓
Symbols are used to denote testing and commissioning requirements, where: ✓ Represents that testing and commissioning shall be required – Represents that testing and commissioning may be required		

Notes:

1. Protection Settings and Performance

The LV non-IES EG backup protection relay shall be tested by secondary injection. Where a backup protection relay has not been installed, the LV non-IES EG integrated protection shall be tested by secondary injection. All functional tests including synchronisation tests shall be carried out to prove the protection and control scheme operates as per the design.

2. Power Quality Settings and Performance

On-load tests shall be undertaken after protection settings and performance tests have been completed. During these on-load tests, the value of electrical parameters shall be recorded such as LV EG voltage, current, active power, power factor and frequency. On-load tests shall confirm the LV EG regulates:

- voltage and frequency when supplying load in backup mode (if required); and

- active power and power factor within a certain tolerance of the applied settings when synchronised with UE's network

3. Communications performance for monitoring system

Where remote tripping is required, full end-to-end testing of the remote trip scheme is required.

10. Operations and Maintenance

LV EG systems shall be operated and maintained to ensure compliance with their connection agreement and all legislation, codes, and/or other regulatory instruments at all times. The operations and maintenance requirements for LV EG connections, includes:

1. The LV EG system shall be operated and maintained to ensure compliance with the connection agreement and all legislation, codes, and/or other regulatory instruments at all times
2. Confirmation of the maintenance of the LV EG system shall be submitted to UE at a specified interval as agreed with UE

The following documentation is to be kept at the LV EG installation in compliance with relevant codes and is to be readily accessible by UE's representatives:

- A single line diagram showing all electrical metering points, protection functions and zone of coverage.
- A record of all approved protection settings.
- A copy of the approved operating procedures.
- Maintenance plan and records.

In addition, the proponent shall:

1. Maintain and operate the LV EG installation in a safe condition
2. Ensure that any changes to the LV EG installation are performed by an electrician lawfully permitted to do the work and that the proponent holds a Certificate of Electrical Safety (CES) issued in respect of any of the changes
3. Seek UE approval prior to altering the connection in terms of an addition, upgrade, extension, expansion, augmentation or any other kind of alteration, including any changes to protection functions or settings.

If any breach of this technical standard is suspected, UE may undertake an investigation. If the investigation reveals a breach, the proponent shall be required to rectify this breach and pay UE for the costs associated with the investigation and associated works undertaken by UE.

Appendix A: Deviations from the National DER Connection Guidelines

Table 21 Table of deviations from National DER Connection Guidelines

Section	Description of deviation	Type of deviation	Justification
1.1	The maximum system capacity for both LV EG IES and LV non-IES EG system is up to the maximum rating of the main circuit breaker and less than 5MVA, instead of greater than or equal to a set kVA as per the National DER LV EG Connection Guideline. In addition, • only two phase and three phase LV EG IES of greater than 30kVA are allowed • only three phase LV non-IES EG are allowed	Promote improved benefits to Australia's electricity system	Promotes clarity on EG capacity for LV EG connection and differentiates IES capacity requirements from the basic micro connection.
2.1	Definition of IES is different from the National DER LV EG Connection Guideline	To meet jurisdictional requirement	The definition was amended to align with AS/NZS 4777.1:2016.
2.3	Terminology of the word 'may' and 'should' were swapped as described in the National DER LV EG Connection Guideline	Promote improved benefits to Australia's electricity system	Clarifies requirements for proponents
2.3.1	No subcategories based on IES size, unlike National DER LV EG Connection Guideline which set IES subcategories based on size (i.e. ≤ 200kVA or > 200kVA)	Promote improved benefits to Australia's electricity system	Promotes clarity on subcategories by reducing subcategories to only material subcategories
4 (5 in ENA guide)	Moved Fees and Charges section from section 5 as shown in ENA Guideline to section 4	Promote improved benefits to Australia's electricity system	Promotes readability and easier reference with sections 1 – 4 being common to both IES and non-IES EG.
5 – 10 (4, 6 and 7 in ENA guide)	Created Part A for IES specific requirements and Part B for non-IES specific requirements. This is different to the approach from ENA guideline where IES and non-IES requirements were combined in the various sections	Promote improved benefits to Australia's electricity system	Promotes readability and easier reference with dedicated sections for IES and non-IES EG specific requirements
5.3.1, 8.3.1 (4.3.1 in ENA guide)	Export limits at connection point is 10kW for two phase connections and up to maximum rating of the main circuit breaker and total capacity of less than 5MVA for three phase instead of being case by case assessment of whether export limit is required in the National DER LV EG Connection Guideline	Promote improved benefits to Australia's electricity system	To facilitate LV EG connections by streamlining the assessment process whilst not adversely impacting the network

Section	Description of deviation	Type of deviation	Justification
5.7.3, 8.6.2	Added an additional section on switchgear and control gear requirements	To meet jurisdictional requirement	To ensure associated equipment with LV EG are compliant with AS and international standards
5.8, 8.7 (4.8 in ENA guide)	Sustained voltage limit of 258V was used instead of 260V stipulated in AS 4777	Promote improved benefits to Australia's electricity system	Maximum overvoltage limit to maintain network stability and avoid nuisance tripping
5.10.1, 8.9.1	Added an additional section on network ancillary services requirements	Promote improved benefits to Australia's electricity system	To ensure system stability when the LV EG provides network ancillary services
5.11, 8.10	Added an additional section on embedded networks with EG	Promote improved benefits to Australia's electricity system	To ensure EG within an embedded network will not adversely impact the network
5.12.1, 8.11.1	Communication requirements for EG systems > 1000kVA instead of 200kVA in the National DER LV EG Connection Guideline	Promote improved benefits to Australia's electricity system	Promotes clarity on communication requirements to only systems that require remote trip

Appendix B: Connection Arrangement Requirements

Typical LV EG IES configuration with no export limit conditions imposed

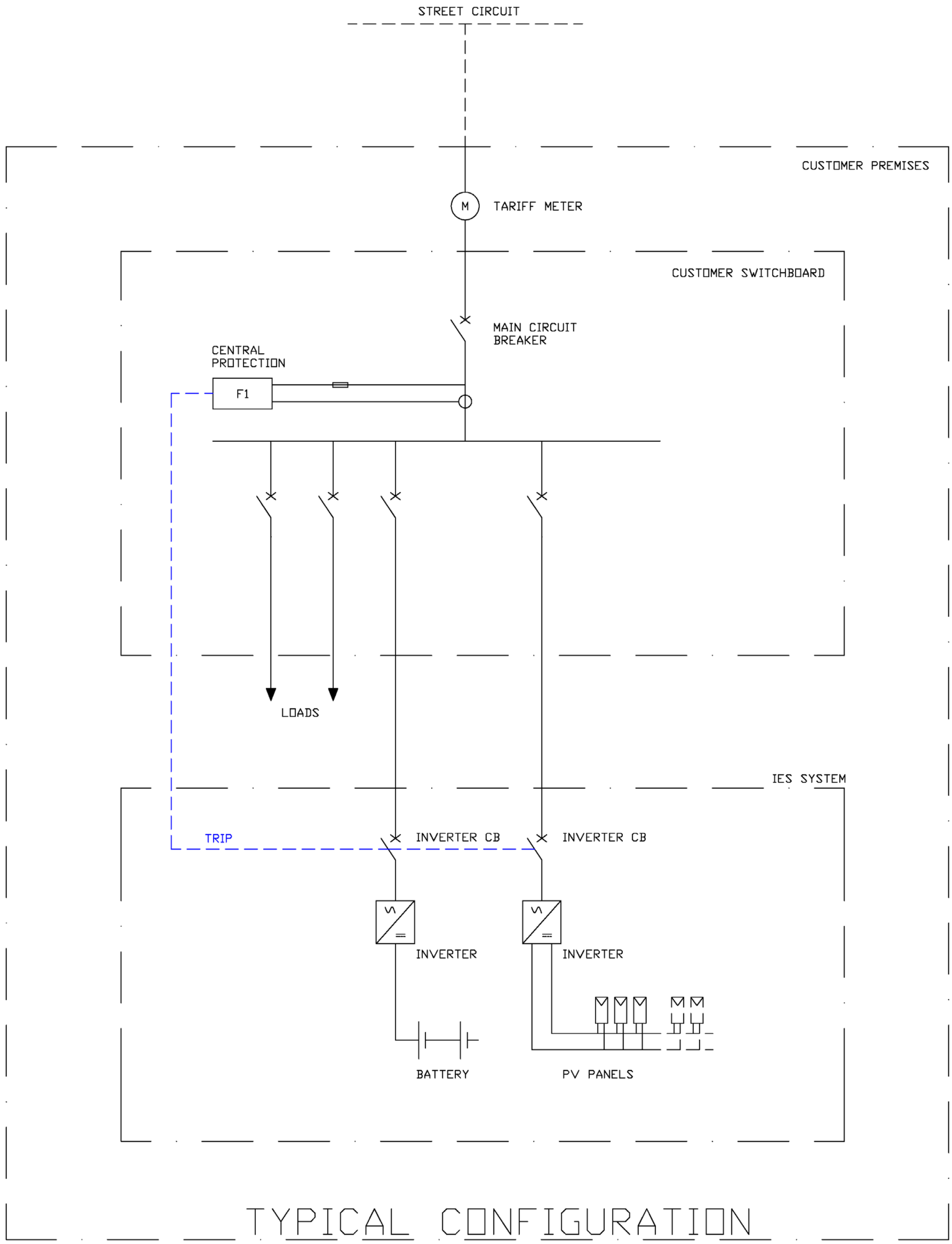

Figure 12: Typical LV EG IES with no export limit conditions imposed

Typical LV EG IES configuration with export limit conditions imposed

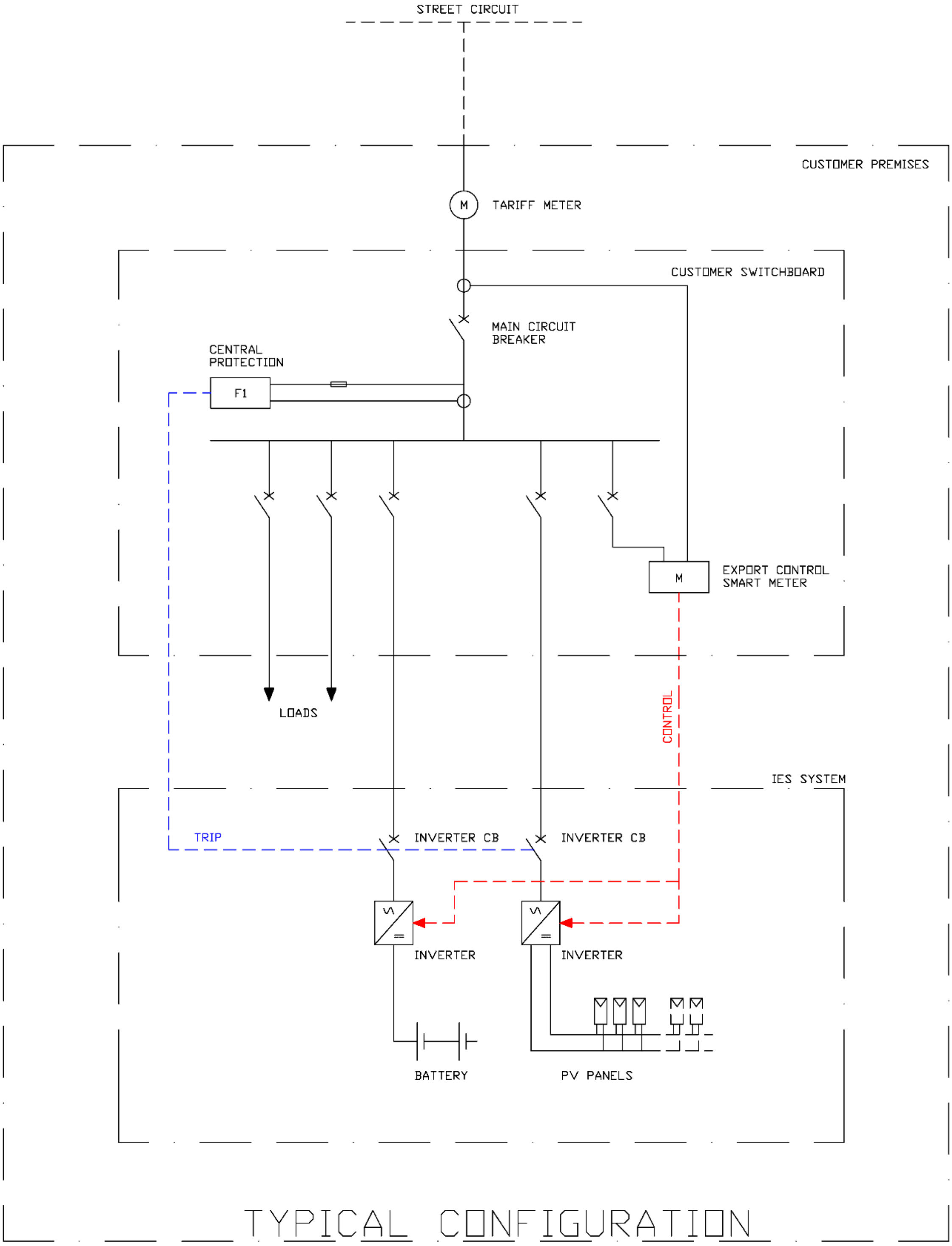

Figure 13: Typical LV EG IES with export limit conditions imposed

Typical LV non-IES EG configuration

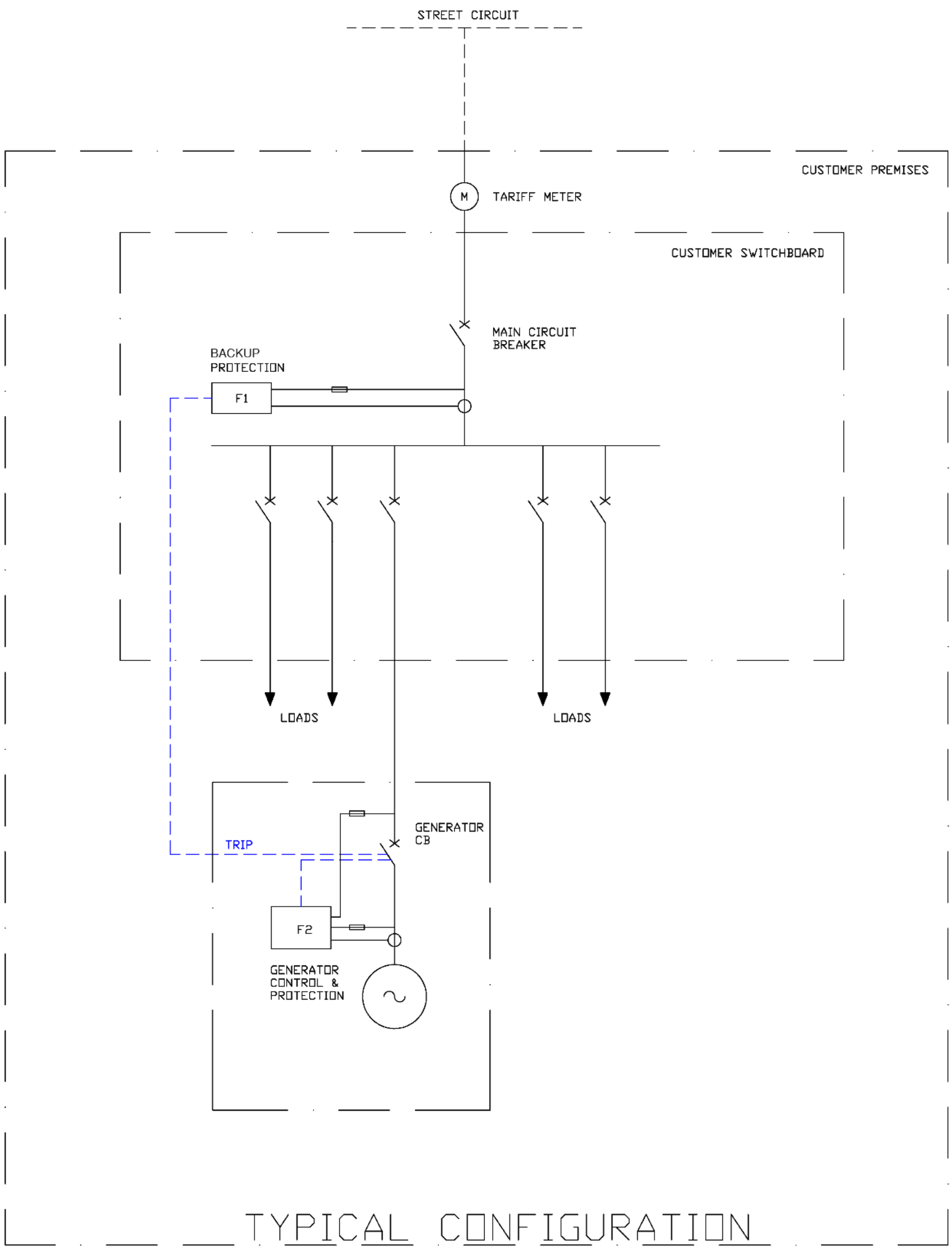

Figure 14: Typical LV non-IES EG

Typical LV IES and non-IES EG configuration with no export limit conditions imposed

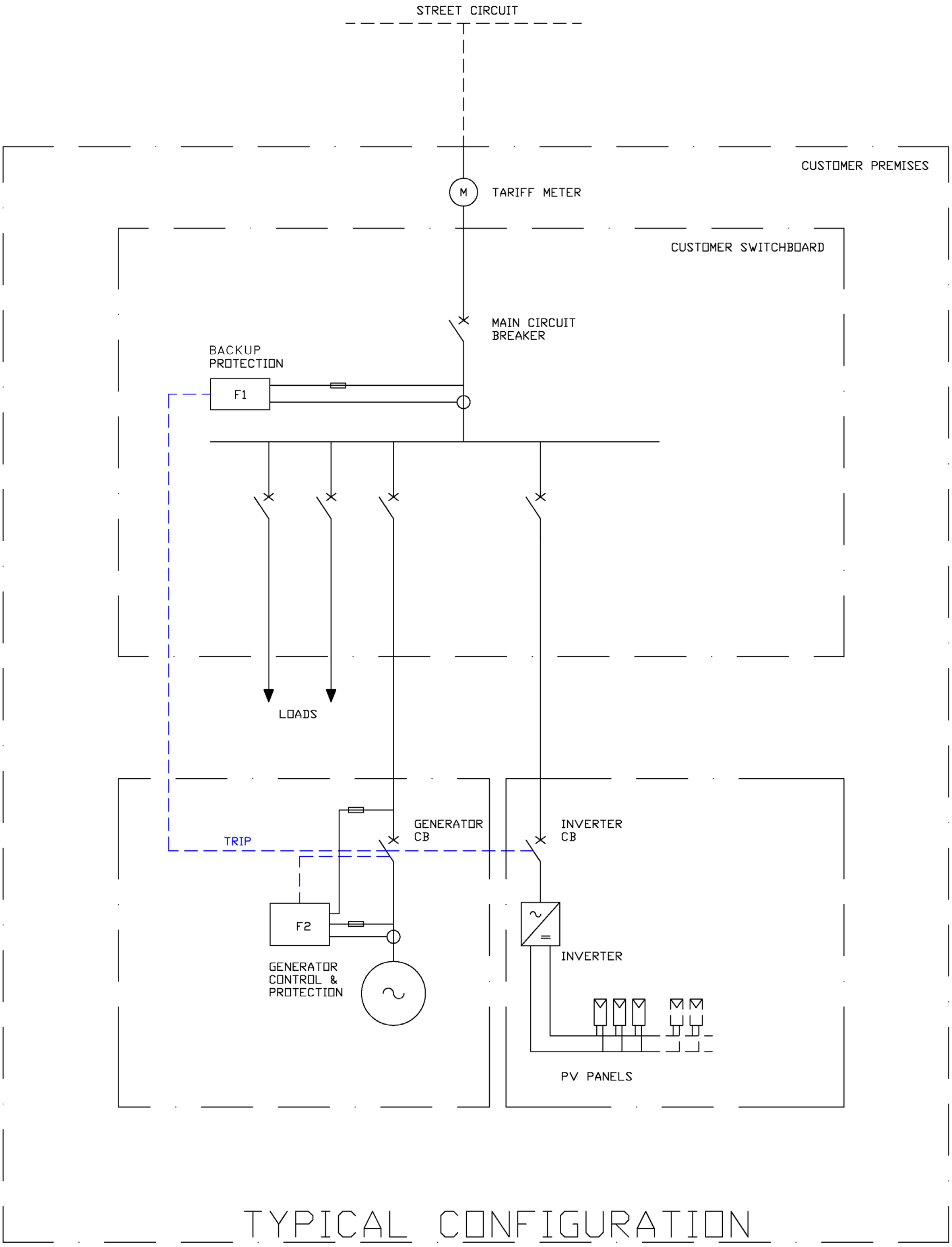

Figure 15: Typical LV IES and non-IES EG with no export limit conditions imposed

Typical LV IES and non-IES EG configuration with export limit conditions imposed

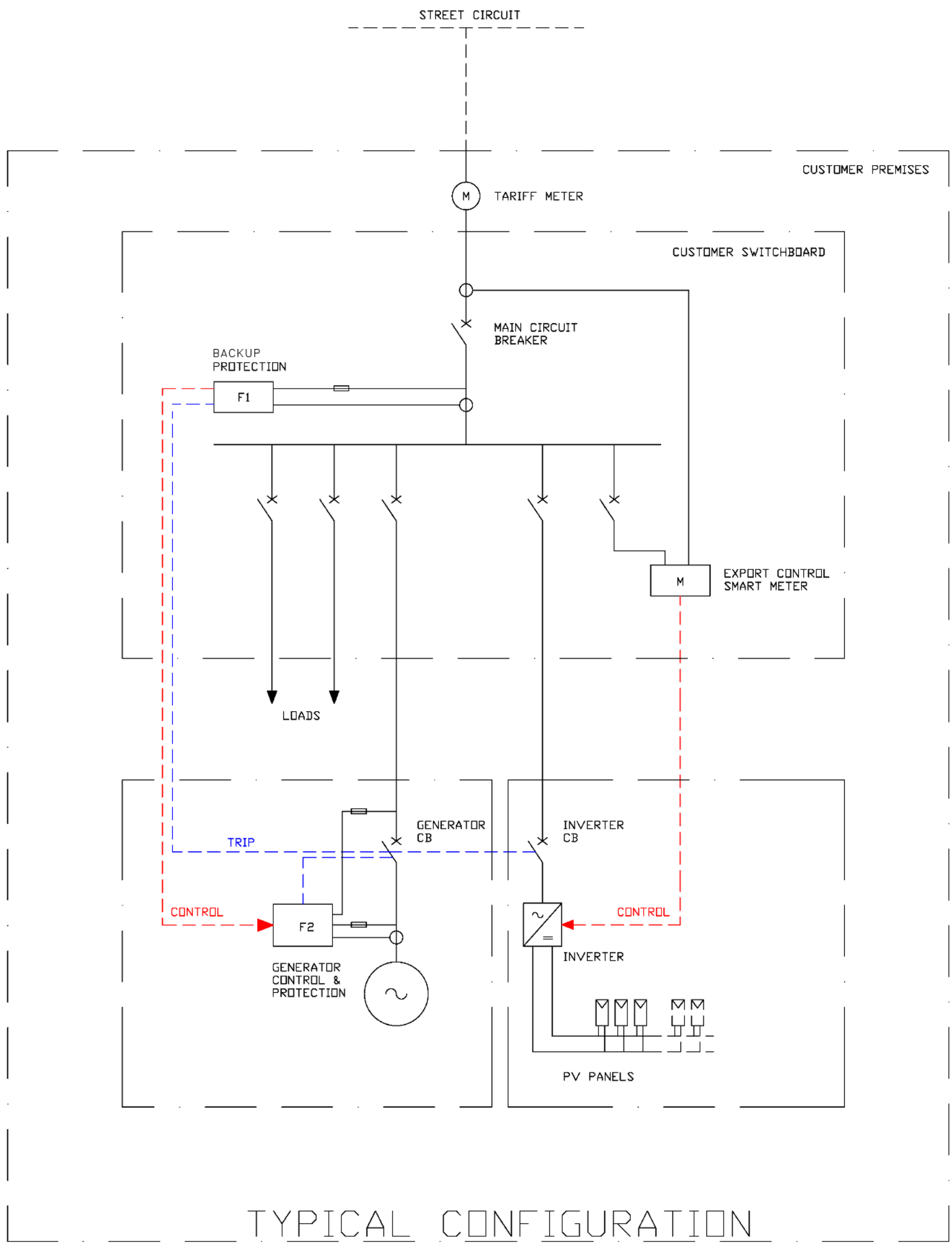

Figure 16: Typical LV IES and non-IES EG with export limit conditions imposed

Appendix C: Sample Offer to Connect

A sample offer to connect can be found on UE's website[8].

For non-registered LV EG customers, please refer to the document titled:
Chapter 5A Distribution Negotiated Connection Generator Agreement – Sample

For registered LV EG customers, please refer to the document titled:
Chapter 5 Distribution Negotiated Connection Generator Agreement – Sample

[8] https://www.unitedenergy.com.au/industry/solar-energy/negotiated

Appendix D: Static Data and Information

Static data and information to be provided by the proponent on the LV EG connection can be found on UE's website[9].

For LV EG IES connections, please refer to the form titled:
UE-FM-5003 IES Commissioning Form

For LV non-IES EG connections, please refer to the form titled:
UE-FM-5004 Non-IES Commissioning Form

For LV connections with both IES and non-IES EG, please refer to the form titled:
UE-FM-5005 Combined Commissioning Form

[9] https://www.unitedenergy.com.au/industry/solar-energy/negotiated

UE-ST-2008.2 LV EG Network Access Standard

Final Audit Report 2020-12-21

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