Part of Energy Queensland

STNW3522

Standard for Large Customer Connections

Effective from 13 July 2026

This Standard has been created and made available for the construction of Energex and Ergon Energy Network infrastructure. It ensures that all work undertaken meets Energex and Ergon Energy Network's technical and operational requirements. External organisations must not use this Standard for the construction of non-Energex and non-Ergon Energy Network assets.

If this Standard is a printed version, to ensure compliance, reference must be made to our relevant website to obtain the latest version.

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Abstract: This Standard has been prepared by Energex and Ergon Energy Network to provide Large Customers with information about their rights and obligations in respect of connecting to, and interfacing with, the Energex or Ergon Energy Network Distribution Network.

Keywords: Large Customer Connections, Connection Agreement, Connection Assets, Connection Point, DER Standards, Distribution Connected Units, National Electricity Rules (NER), Inverter Energy System.

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1 Introduction

1.1 Purpose

We (DNSP, Ergon Energy Network, Energex, we, our or us) have developed this Standard in order to specify the technical requirements that Large Customers must comply with to establish a new connection, or to alter an existing connection, with the Energex or Ergon Energy Distribution Network.

1.2 Scope

This Standard is intended for use by parties whose connection is designated as a Large Customer Connection.

Large Customer Connections are defined in our Annual Pricing Proposal as those connections that generally fall within the tariff classes of Connection Asset Customer (CAC), Individually Calculated Customer (ICC), distribution connected unit operators and real estate developers. Large Customer Connections will typically include:

a) large commercial premises where the total requested capacity is greater than 1,000 kVA (1 MVA),

b) distribution connected units with an installed capacity of greater than 30 kVA, or

c) real estate developments.

In addition, this Standard may also apply to:

- Registered Participants, including Generators and Integrated Resource Providers; and
- Embedded Networks that are not Registered Participants, where the parent Connection Point would involve a category described in a) - c) above. For Embedded Networks, requirements shall apply at the parent Connection Point of the Embedded Network.
- Further information on the technical aspects of large customer connections is provided in the connection manuals and technical standards available on our website.

1.3 Obligation of Large Customers

Large Customers must comply with our applicable connection process (and associated requirements) and the terms and conditions of their connection agreement(s) before establishing or altering a Connection. Further information is available in our Large Customer Connection Manual. It is not intended to be applied retrospectively to existing Connections where there have been no changes or alterations.

1.4 Summary of the Connection Process

A description of the Large Customer Connection process along with the applicable regulatory framework is set out in our Large Customer Connection Manual, as well as the Large Customer sections of our Ergon Energy Network and Energex websites (Ergon Energy | Energex) for further information.

2 References

There are a range of applicable standards and industry codes which define connection types and requirements, and network standards as set out below.

In the event of any inconsistency between:

- Australian and international standards and industry codes (except for legislated industry codes); and
- this Standard,

this Standard will prevail.**Legislation, Regulations, Rules, and Codes**

Set out below is a list of the relevant legislation, regulations and references.

In the event of any inconsistency between:

- legislation and regulation; and
- this Standard,

the legislation and regulations shall prevail.

Document	Type
Construction and operation of solar farms – Code of Practice 2019	Code of Practice
Electricity Act 1994 (Qld)	Legislation
Electricity Regulation 2006 (Qld)	Regulation
Electrical Safety Act 2002 (Qld)	Legislation
Electrical Safety Regulation 2013 (Qld)	Regulation
Electricity – National Scheme (Queensland) Act 1997 (Qld)	Legislation
National Electricity (Queensland) Law, as defined in the Electricity – National Scheme (Queensland) Act 1997 (Qld)	Legislation
National Energy Retail Law (Queensland) Act 2014 (Qld)	Legislation
National Energy Retail Law (Queensland), as defined in the National Energy Retail Law (Queensland) Act 2014 (Qld)	Legislation
National Electricity Law	Legislation
National Electricity Rules	Regulation
Professional Engineers Act 2002 (Qld)	Legislation
Distribution Determination Ergon Energy 2025-2030	Reference
Distribution Determination Energex 2025-2030	Reference
Ergon Energy Connection Policy	Reference
Energex Connection Policy	Reference

Document	Type
Ergon Energy Tariff Structure Statement	Reference
Energex Tariff Structure Statement	Reference

2.2 Australian and New Zealand Standards

Document Number	Document Name
AS 2067	Substations and high voltage installations exceeding 1 kV a.c.
AS/NZS 3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3835.1	Earth potential rise – Protection of telecommunications network users, personnel and plant (Part 1: Code of Practice)
AS/NZS 3835.2	Earth potential rise – Protection of telecommunications network users, personnel and plant (Part 2: Application Guide)
AS/NZS 4777.1	Grid Connection of energy systems via inverters (Part 1: Installation Requirements)
AS/NZS 4777.2	Grid Connection of energy systems via inverters (Part 2: Inverter Requirements)
AS/NZS 4853	Electrical hazards on metallic pipelines
AS 7000	Overhead line design standard
AS 60038	Standard Voltages
AS/NZS 61000 Series	Electromagnetic compatibility
AS 61869.1	Instrument transformers, Part 1: General requirement
AS 61869.2	Instrument transformers, Part 2: Additional requirements for current transformers
AS 61869.3	Instrument transformers, Part 3: Additional requirements for inductive voltage transformers
AS 61869.4	Instrument transformers Additional requirements for combined transformers
AS/NZS 60255.1	Measuring relays and protection equipment, Part 1: Common requirements
AS/NZS 60255.26	Measuring relays and protection equipment, Part 26: Electromagnetic compatibility requirements
AS/NZS 60255.27	Measuring relays and protection equipment, Part 27: Product safety requirements
AS/NZS 60255.127	Measuring relays and protection equipment, Part 127: Functional requirements for over/under voltage protection
AS/NZS 60255.181	Measuring relays and protection equipment, Part 181: Functional requirements for frequency protection

2.3 International Standards

Document number	Document name
IEEE Std 519 – 2014	IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

2.4 Controlled Documents

Please note that this Standard reflects our policies and procedures and relevant regulatory arrangements at the time of publishing, and these may change from time to time. A copy of the latest version of this Standard and associated fact sheets may be found on our Large Customer Connections "Standards, Manuals & Fact Sheet" landing page on our website (Ergon Energy | Energex).

For further details please refer to our Design and Construction Standards, which are available at Contractors | Ergon Energy or Technical documents | Energex.

Controlled documents relevant to this Standard include:

Document	Alternative Doc ID
Developers Handbook Developers Design and Construct Work - 14340283	Ergon Energy Procedure
Dynamic Standard for Low Voltage EG Connections - 3427416	STNW3511
Queensland Electricity Connection Manual - 2912908	01811 / NA000403R328
Standard for Low Voltage EG Connections - 3055320	STNW1174
Standard for High Voltage EG Connections - 2946177	STNW1175
Standard for Plant Energisation - 3059318	STNW1179
Standard for Large Customer Connections - 9148501	STNW3522
Network Physical Security - Design Reference – 13158190	STNW3039
Large Customer Connection Manual - 3040635	00768 / NA000403R523

3 Definitions and Abbreviations

3.1 Definitions

For the purposes of this standard, the following definitions apply.

Term	Definition
Accredited Auditor	Has the meaning given to that term in the *Electrical Safety Act 2002* (Qld)
Alternative Control Services (ACS)	ACS refers to customer-specific services that are provided on a 'user-pays' basis, meaning the full cost is borne by the customer requesting the service. These services may be competitive and are typically related to connection and asset relocation services.
Build, Own and Operate (BOO)	Refers to either: • For Customer Assets, the Large Customer (including a contactor/consultant engaged by the Large Customer) designs and constructs the Customer Assets and retains ownership and operational control over those assets; or • For Distribution Network Service Provider (DNSP) assets, the DNSP designs and constructs the Connection Assets and retains ownership and operational control over those assets.
Connection Agreement	Depending on the context, refers to a contract between the DNSP and the Large Customer in respect of either or both of the following: • agreement to carry out certain works to either establish or alter a Connection (typically, this may be a Negotiated Connection Establishment Contract); • agreement for the provision of Ongoing Services (typically, this may be a Negotiated Ongoing Connection Contract).
Connection Applicant	A Large Customer that has or intends to submit a Connection Application. For the avoidance of doubt, where another party submits a Connection Application on behalf of the Large Customer (for example, as described in the relevant definition in rule 5A.A.1 of the NER or a contractor or consultant engaged by the Large Customer) the Connection Applicant is the Large Customer, not the party submitting the Application.
Connection Application	An application to establish or alter a Connection in accordance with the process and requirements set out in Chapter 5 or Chapter 5A of the NER (as applicable).
Connection Assets	Components of the Distribution System used to provide connection services for a Large Customer. For the avoidance of doubt, the Connection Assets will not include any assets that are owned or operated by the Large Customer.

Term	Definition
Connection Services	means either or both of the following: (a) a service relating to a new connection for premises of a Large Customer; (b) a service relating to a connection alteration for premises of a Large Customer
Connection Point (CP)	The physical point or link where the Connection Assets meet the Customer Assets to permit the flow of electricity between the premises and Distribution System, being the agreed point of supply.
Current Transformer (CT)	Measurement transformer for current.
Customer Asset	Assets that are owned and/or operated by a Large Customer downstream of the Connection Point.
DER Standard(s)	DNSP Standards relating to DER Systems. At the date of publication, this refers to STNW1174, STNW1175, and STNW3511, which may be appliable for a Large Customer.
DER System	Means the Distribution Connected Units (including ancillary equipment such as protection and control mechanisms) to be interconnected with and connected (directly or indirectly) to the Distribution System at the Connection Point.
Design, Construct and Transfer (DCT)	Refers to circumstances where a Large Customer constructs the Transferable Connection Assets and intends to gift those assets to the DNSP upon completion (from which time those assets will become Connection Assets and the DNSP will have ownership and operational control).
Distribution Connected Bidirectional Unit	A Bidirectional Unit connected within a Distribution System and not having direct access to the transmission network.
Distribution Connected Generating Unit	A Generating Unit connected within a Distribution System and not having direct access to the transmission network
Distribution Connected Unit	Refers to Distribution Connected Generating Units and/or Distribution Connected Bidirectional Units
Distribution Connected Unit Operator	A person who owns, controls or operates a Distribution Connected Unit
Distribution Network Service Provider (DNSP)	The entity who owns and operates the Distribution System being Ergon Energy Corporation Limited or Energex Limited depending on the relevant location.
Distribution System	The relevant Distribution Network, together with the Connection Assets associated with that Distribution Network to which the Large Customer is, or will be, connected.
Diverse (Communication) Paths	Refer to using multiple telecommunication routes, where there is sufficient segregation such that a single credible action or failure event does not result in a total loss of connectivity.

Term	Definition
Dynamic Connection Standards	Standards created that achieves the functional requirements as described in Section 4.5.1 of this standard. At the date of publication, this refers to STNW3511.
Embedded Network	A private electrical network, connected at a parent Connection Point to either: • a Distribution System that forms part of the *national grid*; or • another private electrical network which is owned, controlled or operated by a person who is not a DNSP.
Energy Laws	Has the meaning given to that term in the NERL, which, for the avoidance of doubt, includes the Electricity Distribution Network Code under the Electricity Act 1994 (Qld). Relevant laws relating to the subject matter of this Standard at the date of publication are set out in Section 2.1 (NB this list may not be exhaustive or complete).
Energy and Safety Laws	Means: a. the Energy Laws; b. the Safety Laws; and c. any other relevant rules, regulations, instruments and plans;
Energy Storage System (or ESS)	A system comprising one or more components (e.g. batteries) that store electricity generated by Distributed Energy Resources or directly from the grid, and that can discharge the electricity to loads.
Enhanced connection services	Categorised as ACS, connection services provided at the request of a customer or third party include those that are: • provided with higher quality of reliability standards, or lower quality of reliability standards (where permissible) than required by the NER or any other applicable regulatory instruments • in excess of levels of service or plant ratings required to be provided by the distributor • establishment of a second Connection Point at a premises, and • removal of a constraint for a distribution connected generating unit, including to remove a static zero export limit for a Micro DER connection.
Generating Unit	The plant used in the production of electricity and all related equipment essential to its functioning as a single entity.

Term	Definition
Generator	A person who engages in the activity of owning, controlling or operating a DER System that is connected to, or who otherwise supplies electricity to, a transmission system or Distribution System and who is registered by AEMO under Chapter 2 of the NER as a Generator. For the purposes of Chapter 5, the term includes a person who is required or intends to register in that capacity or a non-registered DER provider who has made an election under clause 5A.A.2(c).
High Voltage (HV)	Any voltage greater than 1 kV a.c.
Integrated Resource Provider	A person who is registered by AEMO as an Integrated Resource Provider under Chapter 2 of the NER. For the purposes of Chapter 5, the term includes a person who is required or intends to register in that capacity or a non-registered DER provider who has made an election under clause 5A.A.2(c).
Inverter Energy System (or IES)	A system comprising one or more inverters together with one or more energy sources (which may include batteries for energy storage) and controls.
Low Voltage	A voltage of no more than 1,000 V a.c. or 1,500 V d.c.
Large Customer	Refers to an entity or person that comes within the scope described in Section 1.2 of this standard.
Micro Resource Operator	Customers who operate, or propose to operate, a Distribution Connected Unit for which a Micro DER Connection is appropriate
Micro DER Connection	A connection between a Distribution Connected Unit and a Distribution Network of the kind contemplated by Australian Standard AS 4777 (Grid connection of energy systems via inverters).
National Electricity Law (or NEL)	The *NEL* as it applies in Queensland under the National Electricity (Queensland) Law, as defined in the *Electricity - National Scheme (Queensland) Act 1997* (Qld), and under which the NER are established.
National Electricity Market (or NEM)	The name of the wholesale electricity market in Australia and the associated interconnected *national grid*.
National Electricity Rules (or NER)	The NER are made under the NEL. The NER governs the operation of the NEM.
National Energy Retail Law (or NERL)	The National Energy Retail Law (Queensland), as defined in the *National Energy Retail Law (Queensland) Act 2014* (Qld).
Network	The apparatus, equipment, plant and buildings used to convey, and control the conveyance of, electricity excluding any Connection Assets. In relation to a Network Service Provider, a network owned, operated or controlled by that Network Service Provider.
Non-registered DER provider	A Distribution Connected Unit Operator that is neither a Micro Resource Operator nor a Registered Participant

Term	Definition
Ongoing Services	Refers to the provision of ongoing connection services by the DNSP to the relevant Large Customer at the Connection Point. For the avoidance of doubt, this may cover *customer connection services*, *connection services* or *network services*.
Premises	Means any land (whether a single block or multiple contiguous blocks), building(s) (whether whole or part), and structure(s) (or adjuncts thereto) that are owned, occupied or controlled by the Large Customer in the vicinity of the proposed connection, and which can reasonably be considered to be part of a single overarching operation.
Protection Scheme	A grouping of primary and secondary plant intended to detect and clear all credible fault scenarios from a section of an electrical network. A scheme can include (but is not limited to) protection relays, communications systems, interposing relays, instrument transformers and circuit breakers.
Protection System	A number of protections schemes intended to detect and clear all credible fault scenarios from a Network, that meet the requirements of the Energy Laws and meet operational requirements.
Registered Participant	A person who is registered by AEMO in any one or more of the categories described in Chapter 2 of the NER.
Service Provider	A person or organisation on the Approved Contractors' Register approved by the DNSP to carry out design and/or construction of certain electrical works for assets on the basis of experience and meeting registration and certification requirements.
Shared Network Assets	All the assets on the Distribution Network, excluding Connection Assets, for the conveyance of electricity to more than one Distribution Network User.
Standard Control Services (SCS)	SCS covers services central to the supply of electricity, essential for the operation of the network, and are funded through regulated network charges paid by all customers.
Sub-transmission	DNSP's Network for the purpose of carrying electricity from bulk supply substations to zone substations. Normally includes 132kV, 110kV, 66kV feeders and many 33kV feeders in Queensland.
Technical Study	A study to evaluate the effects that the proposed connection will have on the Distribution System.
Transferable Connection Assets	Refers to assets constructed by or on behalf of a Large Customer in respect of a Large Customer Connection where, under the terms of the Negotiated Connection Establishment Contract, the ownership of these assets is to be transferred to the DNSP upon completion (refer to Manual for further information on this arrangement).
Voltage Transformer (VT)	Measurement transformer for voltage.

3.2 Abbreviations

This list does not include well-known unambiguous abbreviations, or abbreviations defined at their first occurrence within the text.

Term, abbreviation or acronym	Definition
AEMO	Australian Energy Market Operator
AS/NZS	A jointly developed Australian and New Zealand Standard
AS	Australian Standard
BOO	Build, Own and Operate
CAD	Computer Aided Design
CBD	Central Business District
C&I	Commercial & Industrial
DCT	Design, Construct and Transfer
DER	Distributed Energy Resource
GDD	Grid Disconnection Device
GIS	Geographic Information System
HV	High Voltage
IPR	Interface Protection Relay
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
LV	Low Voltage
MIR	National Metering Installation Requirements
NER	National Electricity Rules
NVD	Neutral Voltage Displacement
PQ	Power Quality
QECM	Queensland Electricity Connection Manual
RPEQ	Registered Professional Engineer of Queensland
SLD	Single Line Diagram
STATCOM	Static synchronous compensator

4 Technical Requirements

4.1 General Requirements

This Standard applies to connections that come within the scope defined in Section 1.2. The technical requirements set out in this Standard are applicable to:

- all new Large Customer Connections
- connected Large Customers proposing to undertake a change to their connection, for example (but not limited to), additional demand that necessitates augmentation, addition of generation, or changes to the performance of the Premises that requires a review of existing arrangements to align to this standard.

Large Customer Distributed Energy Resource (DER) Systems shall also be subject to our DER Standards, which at the date of publication are as follows:

a) STNW1174 – For DER Systems connected at low voltage as fixed DER System Connections

b) STNW3511 – For DER Systems connected at low voltage as Dynamic Connections

c) STNW1175 – For DER Systems connected at high voltage

Generally, DER Systems will be subject to additional conditions - refer to the relevant standards above. Where it is unspecified for any category within this standard, it shall be assumed that the requirement is common for all Large Customers.

4.2 Shared Secondary Systems

4.2.1 DC Supplies

DC supplies shall come from the DNSP. Shared DC supplies with the customer are ***generally not*** allowed.

Exceptions to this rule must be sought from our Connection Standards team, possible exceptions may be granted where:

- Existing C&I sites adding remote generation, where a second DC supply is required but can't fit in existing room. In this case a second DC supply may come from the customer, provided there is voltage and current monitoring, and a loss of DC is alarmed in SCADA.
- Customer sites that have only SCADA signals and/or power quality analyser (some generation sites under STNW1175), that only supplies a 100W modem.

4.2.2 Protection Wiring and Signalling

Where there are shared CT protection cores, VT supplies, circuit breaker controls or indications they shall be wired via a customer interface panel with terminals for the customer to connect their wiring. In some cases, circuit breaker functions may be shared via protection signalling.

Protection panels at the customer end of a differential scheme may be included at a customer site, in accordance with the DNSP's standard drawings.

Where the DNSP's cubicles are not in a dedicated lockable room, cabinets shall have an outer door with a DNSP hasp and lock, and a remote door sensor monitor on the inner door.

4.2.3 Communication & SCADA

Communication panels at the customer end shall be in accordance with the DNSP's standard drawings.

Where the DNSP's cubicles are not in a dedicated lockable room, cabinets shall have an outer door with a DNSP hasp and lock, and a remote door sensor monitor on the inner door.

4.3 Labelling and Signage

All installations shall comply with AS 2067 and AS/NZS 3000.

The DNSP shall provide the Large Customer with details of the operational and identification labels that the Large Customer shall place on items of equipment, substation buildings and enclosures comprising the Transferable Connection Assets and other assets that are required for isolating access to the Distribution System. The unique ID of switching plant at the Connection Point shall not be changed without consultation with the DNSP. The Large Customer shall provide the DNSP with a list identifying each item of equipment with label identification, make, model and serial number.

4.4 Maximum System Capacity

4.4.1 Aggregate Capacity Considerations

The maximum capacity for any Connection Point in respect of a Premises is based on the aggregate[T] of all the maximum demand or connected capacity of the DER Systems authorised to be connected within that Premises.

For Premises with multiple Connection Points, or DER System(s) within a Premises being connected to multiple Connection Points:

a) The maximum capacity for any Connection Point in respect of a Premises is based on the aggregate of all the maximum demand or connected capacity of the DER Systems authorised to be connected within that Premises.

b) The requirements set out in this Standard and any Technical Study will be applied and determined based on the aggregate maximum capacity of all the distribution connected units and the maximum aggregate demand, or proposed aggregate to be connected, within the Premises.

This aggregate capacity consideration is irrespective of any interlocking or electrical separation of the multiple supplies at the Premises.

[T] Note: Stand-by (break-before-make) DER systems that do not operate in parallel with the DNSP network are excluded from the maximum capacity aggregate.

The table below is a guide of the maximum load capacity of each voltage level - to be taken into planning consideration when requesting supplies:

Table 1: Maximum Load Capacity Guideline

Voltage Level (kV)	Max Load Capacity (MVA)
LV	1.5*
11	5
22	10
33	40**
66	80
110	130
132	160

** Note: CBD and high-rise installations at LV may access up to 4.5MVA in a standardised arrangement (subjected to DNSP's discretion)*

*** Note2: Not applicable where 33kV is used as 11kV.*

4.5 Connection Control

Large Customer Premises with loads and DER Systems should have a central control mechanism to ensure DNSP performance requirements are met at the Connection Point. A central control scheme shall influence and preferably coordinate all loads and DER Systems within the premise and at the Connection Point. The central control scheme shall be separate to a Protection Scheme at the Large 1Customer's Premises and ensures the performance at the Connection Point complies with the Connection Agreement. Central control schemes can include (but are not limited to):

a) Plant overload or curtailment scheme.

b) Anti-islanding scheme.

The Technical Study shall determine the suitability of the central control scheme as required per Table 2.

Table 2: Central Control Scheme Requirements

Connection Category	Central Control Scheme Requirement[1]
DER System capacity > 1.5 MVA	Shall be required
Load, authorised demand > 3 MVA	May be required at DNSP discretion according to Distribution Network conditions, including connections on the sub-transmission Network and weak Network areas
All other existing Large Customer *load* Connections when adding DER Systems	Required as per DER System or *load* requirement above

Note 1: The control scheme may comprise of a dynamic connection as defined in Section 4.5.1.

4.5.1 Dynamic Connections

The DNSP has enabled dynamic Connection capability for LV Connections. This provides Connections a real time, variable active power import / export limit from the DNSP with capacity limits forecasted ahead. Refer to the relevant Dynamic Connection Standard for further requirements.

4.6 Network Connection and Isolation

The DNSP and the Large Customer shall have an isolation device that can isolate the Connection Point. An isolation device is not used to interrupt faults; rather it is used to physically isolate and disconnect the Large Customer's installation from the Distribution System to facilitate access to perform work on the Distribution System.

The location of the isolation device shall be as close as possible to the Connection Point. The isolation device shall be owned by the DNSP, except for dedicated underground HV distribution feeder Connections. Appendix A details connection arrangements that are permitted for Large Customers.

Where technically feasible, consideration may be given to allowing momentary paralleling of the DNSP's high voltage feeders, to permit transfer from one feeder to the other without interruption to supply. If feasible and approved, this must be documented in an operating protocol that is part of the Connection Agreement.

Permanent paralleling of high voltage feeders to provide a no-break supply may also be considered at the Technical Study, subject to the installation of additional protection at the zone substation and the Large Customer 's installation at the Large Customer's expense.

4.6.1 Grid Disconnection Advice (GDD)

To enable rapid disconnection and minimise Distribution System impact at the Connection Point, a Grid Disconnection Device (GDD) shall be installed at or near the Connection Point.

A GDD shall consist of a HV Automatic Circuit Recloser (ACR) or a HV circuit breaker within a switchboard. The GDD shall be supported by a Protection Scheme covering the requirement of a disconnection device redundancy in Section 4.10.1.

In the instance of a Large Customer owned GDD, a DNSP owned Protection Scheme with remote communication shall be installed at the Large Customer's expense to enable DNSP visibility and disconnection over the GDD. Where a DNSP owned GDD is required for LV Connection Points, this would be installed at the DNSP's discretion.

Where a GDD is not required for a new Large Customer Connection (e.g. on LV load Connections), the Large Customer should consider allowing provision for *plant* space for a GDD enablement in a future scenario of a Connection alteration (i.e. future DER system).

GDD requirements for various Large Customer Connection arrangements are covered in Table 3.

Table 3: GDD Requirements

Supply voltages / Network type	Shared Network / Dedicated	Connection category	DNSP owned GDD required
LV	Shared	Load &/or DER System ≤ 1.5 MVA	No
		DER System > 1.5 MVA	Yes
HV Distribution Network	Dedicated[3]	Load of any size &/or DER System ≤ 1.5 MVA	Typically required[1,2]
	Shared	Load of any size &/or DER System ≤ 1.5 MVA	Yes
	Dedicated[2]	DER System > 1.5 MVA	Yes[1,3]
	Shared	DER System > 1.5 MVA	Yes
Sub-transmission Network	All other Connection arrangements	Load / DER System	Yes

Note 1: By default, for a HV connection, a DNSP owned GDD is typically required at the Connection Point. It will be at the DNSPs discretion if a DNSP owned GDD is not required.

Note 2: Dedicated feeder from a B leg of the substation CB is considered Shared network

Note 3: Refer Appendix A for further details

4.6.2 HV Isolation and Access Requirements

The following shall be provided for safe operation of the Large Customer's HV installation and the Distribution System:

a) The incoming high voltage cable shall be capable of being earthed via a fault make rated earth switch, located on the Network side of the Main Switch or Circuit Breaker as relevant; and

b) The earth switch shall be integral to the high voltage metering transformers and Main Circuit Breaker switchgear assembly; and

c) The earth switch shall be capable of having a DNSP lock in the "OFF" and "EARTHED" positions; and

d) When more than one high voltage supply is provided to a Large Customer, the supplies may require interlocking in such a manner that paralleling of the High Voltage supplies could not be possible, unless arrangements have been made to provide a permanent parallel configuration.

4.7 Earthing

Earthing designs shall comply with the requirements set out in AS/NZS 7000, AS 2067 and AS/NZS 3000 as relevant. Earthing designs may also need to comply with other relevant standards including AS/NZS 3835.1, AS/NZS 3835.2 and AS/NZS 4853.

The applicable requirements in respect of the earthing of the Large Customer's HV installation and the earthing of the Distribution System must be documented in the Connection Agreement, including

whether these must be separated (i.e. isolated) from one another or can be interconnected together (i.e. bonded). Consideration should be made for bonding the Large Customer's HV installation and the Distribution System where secondary systems cross ownership boundaries, or where the two earthing systems cannot be effectively isolated from one another.

4.8 Plant Approval and Compliance

This section sets out *plant* approval and compliance requirements for all Large Customer Connections.

4.8.1 Fault Level of Plant

The Large Customer shall be responsible for ensuring the fault level withstand capability of their *plant* is sufficient and maintained. It is recommended to specify *plant* to equal or greater fault withstand than the fault ratings in Table 5 at the Connection Point and an appropriate scaled level within the Premises, depending on impedances and applicable fault current sources. In the context of Table 5, primary plant is *plant* that is directly associated with a bulk supply or zone substation of DNSP whilst secondary plant is *plant* on the Distribution System downstream of a bulk supply or zone substation circuit breaker. In some circumstances, higher withstand will be required, which will be advised with the Technical Study (see Section 4.16).

Table 4: Fault Withstand Guidelines for Equipment Related to System Voltage

Voltage	Primary plant	Secondary plant
132/110 kV	40 kA / 1s	40 kA / 1s
66 kV	25 kA / 3s	25 kA / 3s
33 kV	31.5 kA / 3s	25 kA / 3s
22 kV	25 kA / 3s	20 kA / 3s
11 kV	25 kA / 3s*	20 kA / 3s*

** Note: This can be 16kA/3s where reclosers are used, provided the fault level withstand capacity is sufficient and maintained.*

4.8.2 Protection Equipment

Protection equipment, both utilised by the DNSP and Interface Protection Relays (IPR) utilised by the Large Customer shall operate the relevant disconnection device either directly or through interposing equipment. Such protection equipment and any interposing equipment shall have certified compliance with the following:

a) AS/NZS/IEC 60255-1 Common requirements

b) AS/NZS/IEC 60255-26 EMC requirements

c) AS/NZS/IEC 60255-27 Product safety requirements

d) AS/NZS/IEC 60255-127 Functional requirements for over/under voltage protection, and

e) AS/NZS/IEC 60255-181 Functional requirements for frequency protection.

Marshalling of protection trips through control equipment shall be compliant with IEC 60255 / AS/NZS 60255.

The instrument transformers used to interface the protection equipment with the Large Customer's installation shall have certified compliance with:

i. AS 61869-1 General requirements

ii. AS 61869-2 Additional requirements for current transformers

iii. AS 61869-3 Additional requirements for inductive voltage transformers, and

iv. AS 61869-4 Additional requirements for combined transformers.

4.9 Operating Voltage and Frequency Settings

The Large Customer shall implement and maintain the operating voltage and frequency settings that are set out in the Connection Agreement, which must not be altered without the written agreement of the DNSP.

4.10 Protection

The design and operation of the Protection Systems associated with a connection of a Large Customer shall be in accordance with the NER, other relevant Energy and Safety Laws and the operational and planning requirements of the DNSP.

The Large Customer shall provide the following to the DNSP (endorsed by Customer's RPEQ):

a) Satisfactory demonstration that the elements of the Large Customer's Protection System coordinate adequately with the DNSP's Protection Systems over the range of credible fault levels common to both the Large Customer's and the DNSP's Protection Systems. Coordination is required at all related protection thresholds including (but not limited to) time and current and/or impedance and/or voltage, etc. The coordination margins shall be determined by the DNSP.

b) Statement from the Customer's RPEQ confirming the Large Customer's Protection System design is compliant with the requirements of the NER, other relevant Energy and Safety Laws and the operational and planning requirements of the DNSP, including (but not limited to):

   i. Detect and clears all credible fault scenarios within the Large Customer's facility.

   ii. Having clearing times as required by the NER and/or the DNSP.

   iii. Having an N-1 Protection System, meaning that there is sufficient redundancy in the protection system to safely and reliably disconnect the faulted equipment. It must be confirmed by the customers RPEQ, that any fault within the Large Customer's installation is able to be cleared with any single element of a protection system out of service. Note the elements of a Protection System can include protection relays and related DC systems, communication equipment and related DC systems, circuit breakers, instrument transformers, etc.

4.10.1 Large Customer Backup Protection

It is the expectation that a Large Customer has a Protection System that has N-1 Protection Schemes. Where the Large Customer's Protection System has only one Protection Scheme, they may request that the DNSP provides a backup Protection Scheme to the Connection Point only. The request shall need to be submitted during the Connection Application. Where an operationally practical solution can be provided by the DNSP, it will be offered and implemented by the DNSP at a cost to the Large Customer.

If the DNSP provides a backup Protection Scheme for a Large Customer, then this shall be documented in the Connection Agreement.

4.10.2 Shared Protection Systems

For standard Protection System arrangement options, refer to Appendix B.

Where Protection Systems span beyond the Connection Point, they are in effect a shared Protection System. These shared Protection Systems shall comply with the following principles.

a) Where Protection Schemes (as a unit protection scheme e.g. feeder differential) include protection relays that are maintained and operated by the Large Customer, these relays shall comply with the DNSP's present protection relay period contracts. The relay period contract stipulates relay models, relay firmware versions and proprietary setting configuration software versions; and

b) The Large Customer shall comply with our standard application guides for each relay application. The DNSP's standard application guide covers standardised protection settings for a particular relay model with regards to the functions required in its application.

4.10.3 Communicating Protection Schemes

Communicating line Protection Schemes shall be limited to either two or three ends. Four ended schemes are not supported by the DNSP.

4.10.4 Inter-tripping

The Large Customer's Protection System design shall not be based solely on an inter-trip from the DNSP. Direct inter-tripping from or to the DNSP can be an ancillary part of a Protection System, such as a direct inter-trip resulting from a circuit breaker fail.

Inter-tripping as part of a control scheme is not considered part of a Protection Scheme.

4.11 Metering

The metering system design needs to be considered by the Large Customer as part of its planning phase with respect to the location of voltage and current transformers, metering panels and associated equipment, as well as ensuring compliance with the requirements set out in the NER, QECM and National Metering Installation Requirements (MIR).

Approval to connect shall only be granted by the DNSP for compliant NER arrangements.

Regardless of ownership, the DNSP will require copies of the CT and VT test certificates prior to energisation. Where the measurement transformers are owned by the Large Customer, reports of recent maintenance history shall be made available if these assets provide secondary functions for the DNSP. Where the DNSP has agreed to allow the Large Customer access to metering cores on its CT and/or VT, the Large Customer must in return agree to cover the costs associated with the mandatory accuracy verification testing. Any change to the operation of these assets shall be reported to the DNSP. All test certificates are required to be NATA or ILAC accredited.

4.12 Power quality

4.12.1 General

All power quality measurements, allocations and limits are with reference to the Connection Point.

All Large Customers shall comply with the performance standards set out in their Connection Agreement, Australian Standards and Energy and Safety Laws that are associated with power quality parameters. This may include, but not be limited to voltage fluctuation, voltage unbalance, harmonic emission limits or power factor requirements to assist the DNSP in maintaining Network capability, power system security, quality and reliability of supply.

Compliance with the power quality (PQ) limits as defined in the Connection Agreement shall be demonstrated in the following manner:

a) For a Generator or Integrated Resource Provider, as part of the commissioning process as per rule 5.8 of the NER;

b) For Non-registered DER providers, as part of the commissioning processes described in STNW1174 and STNW1175, as applicable;

c) at DNSP discretion for Large Customers with disturbing loads, within three months of reaching full operational capability; and

d) at DNSP discretion for all Large Customers if non-compliance is suspected.

Where requested, the Large Customer shall provide the DNSP with an RPEQ certified Power Quality Report presenting the power quality limits and the recorded results in accordance with the requirements set out in the Connection Agreement, to demonstrate compliance with the performance standards referred to in the Connection Agreement. The DNSP may at any time during the term of the Connection Agreement require the Large Customer to retest the performance requirements and provide evidence that the Large Customer is still compliant at the Connection Point.

Large Customers are required to monitor the Connection Point to maintain their continual compliance with the PQ limits set out in the Connection Agreement.

4.12.2 Voltage Fluctuation and Flicker

Voltage fluctuations are random or continuous variations of the Root-Mean-Square (RMS) voltage. Voltage fluctuations may be caused by rapid current changes by customer *load* switching and equipment starting, motor starts, arc furnaces, generators and welding equipment.

Flicker is the impression of fluctuating luminance resulting from voltage fluctuations on the supply systems defined in AS 61000 series as follows:

- $\mathbf{P_{st}}$: the short-term flicker severity index where a value is obtained for each 10 minute period.
- $\mathbf{P_{lt}}$: the long-term flicker severity index where a value is obtained for each 2 hour period.

It is a requirement that the Large Customer maintains compliance with the emission limits as defined in the performance standards referred to in the Connection Agreement.

4.12.3 Harmonic distortion

Harmonic distortion of the voltage waveform is the result of non-linear currents caused by non-linear loads and DER Systems connected to the Distribution Network. Common sources of harmonic distortion include switched mode power supplies, inverter-based technologies, arc furnaces and motors with variable speed drives or variable frequency drives.

Harmonic emission limits will be determined in accordance with Table 2 of IEEE 519 for Large Customers up to and including 1.5 MVA connected at LV, and in accordance with AS/NZS 61000.3.6:2001 for all other Large Customer Connections.

In the event a Large Customer needs to install a harmonic filter to reduce harmonics to meet the allocated harmonic emission limits, filter costs, construction footprints and delivery timescales can be significant. Therefore, it is important that developers and consultants are aware of the harmonic emission compliance as required by relevant Australian Standards and the NER during the planning for the project. The Large Customer should become familiar with the assessment process, technical specification, possible interactions with the DNSP's Audio Frequency Load Control (AFLC) and any review of the filter design.

4.12.4 Harmonic Modelling requirements

Harmonic modelling is required for DER Systems 5 MVA and over to demonstrate compliance with the harmonic allocation prior to agreement of performance standards. Customers with DER Systems 1.5 - 5 MVA should perform harmonic modelling to ensure compliance prior to energising the Connection Point to avoid additional mitigation measures post-connection.

A harmonic model may be required for distorting loads greater than 5 MVA.

4.12.5 Voltage unbalance

The Large Customer shall ensure that the Connection Point voltage is balanced to achieve an average voltage unbalance less than or equal to the values set in Table 5.

Table 5: Voltage Unbalance Limits

Nominal supply voltage (kV)	Maximum Negative Sequence Voltage (% of Nominal Voltage)			
	No contingency event	Credible contingency event or protected event **	General	Once per hour
	30 minute average	30 minute average	10 minute average	1 minute average
More than 100	0.5	0.7	1.0	2.0
More than 10 but not more than 100	1.3	1.3	2.0	2.5
10 or less	2.0	2.0	2.5	3.0

*** Refer to NER Clause S5.1a7: Voltage unbalance.*

4.12.6 Power Factor

The permissible power factor range at the Connection Point for when the Premises is taking electricity from the Distribution System at the Connection Point, such that the load is equal to or greater than 30% of the authorised demand as permitted under the Connection Agreement for importing electricity from the Distribution Network shall be in accordance with Table 6.

This is consistent with the automatic access standard set out in Table S5.3.1 of the NER and the requirements in the *Electricity Regulations 2006* (Qld).

Table 6: Power Factor for Load-Only Applications

Supply Voltage (Nominal)	Power Factor Range
< 1 kV	0.8 lagging to unity
1 kV < 50 kV	0.90 lagging to 0.90 leading
> 50 kV – 250KV	0.95 lagging to unity

When the Premises are taking electricity from the Distribution Network at the Connection Point such that the load is less than 30% of the authorised demand permitted under the Connection Agreement for importing electricity, the DNSP at its discretion may accept a power factor outside the range stipulated in Table 6, provided this is within the *system standards* and does not breach any Energy and Safety Laws. In some cases, site-specific requirements may necessitate a negotiated requirement, such as significant inverter-based resources to ensure suitable voltage regulation, or connections in weak areas. Sites that incorporate loads and distribution connected generating units operating together shall require a negotiated outcome on the power factor performance.

A Large Customer who installs shunt capacitors to comply with power factor requirements must comply with the DNSP's requirements to ensure that the design does not severely attenuate audio frequency signals used for load control or operations or adversely impact on harmonic voltage levels at the Connection Point.

4.12.7 Plant Energisation

The energisation of plant for new, or modified, Connections shall comply with the requirements of our Plant Energisation Standard STNW1179. Where a PQ meter is not required according to Section 4.12.8 of this Standard, temporary power quality metering may be required to verify compliance.

4.12.8 Power Quality Monitoring

The requirement for a dedicated PQ Class A meter is given as per Table 7.

Table 7: Power Quality Meter Requirements per Connection Category

Connection category		Power quality meter requirement
Loads[1]	Non Sub-transmission Network Connections	May be required for Connections with significant disturbing loads and/or Connections to weak grids as identified by the Technical Study
	Sub-transmission Network Connections	Shall be required for Connections with significant disturbing loads
DER Systems		Refer to relevant DER Standard

Note 1: Authorised demand in the Connection Agreement

A power quality meter shall meet the following requirements:

a) measurement to be based as close as practical to the Connection Point(s); and

b) owned and managed by the DNSP; and

c) the Large Customer is to bear the cost of establishing the power quality meter and required enabling plant including CTs and VTs. Compliant CTs and VTs may be owned by the customer and provide the DNSP owned power quality meter the required inputs. The DNSP owned PQ meter shall require a separately fused VT circuit for measurement; and

d) be available to report and verify the power quality compliance at the Connection Point at any time by the DNSP[1]. Note this only applies where the customer owns the CTs and VTs.

4.13 Communications and SCADA requirements

The Large Customer shall liaise with the DNSP regarding telecommunication requirements to support SCADA communications, protection communications, and/or other applications as required for the associated secondary systems. Table 8 details SCADA and communications requirement for Large Customers.

Table 8: SCADA and Communications Requirements per Connection Category

Connection category		SCADA and Communications requirement
Loads (authorised demand)	Shared feeder Connections in non Sub-transmission Networks	May be required as identified by Technical Study[1]
	Single Feeder Dedicated Connections in non Sub-transmission Networks	May be required as identified by Technical Study[1]
	Multiple Feeder Dedicated Connections in non Sub-transmission Networks	Shall be required
	Sub-transmission Networks Connections	Shall be required
DER Systems		Refer to relevant DER Standards
Load and Generation hybrid sites		As required by the more onerous categorisation of the *load* or generation component

Note 1: The requirement will consider shared Distribution Network topology, GDD ownership and visibility, PQ meter availability, protection and control requirements for the Large Customer.

In certain cases, there may be a requirement for control systems to have communications where an automatic *load* curtailment scheme or plant overload Protection Scheme is required.

[1] With reasonable allowance for outages

4.13.1 Roles and Responsibilities

Due to the requirements for security and interoperability with the DNSP's existing telecommunications networks, the DNSP shall undertake the communications system design, provide equipment specifications and shall therefore determine the configuration of the equipment.

The Large Customer shall be responsible for installing the communications transmission and switching equipment based on this design, as per the installation process and procedures outlined by the relevant DNSP Standards made available during the application process.

The DNSP may, upon request and for an appropriate fee, provide equipment installation and as constructed engineering drawings on behalf of the Large Customer.

Testing can be performed by the Large Customer at the Connection Asset substation as part of an integrated program to test the substation.

Unless otherwise agreed with the DNSP, a Large Customer wishing to achieve inter-networking under the Build, Own, Operate (BOO) model defined in our Large Customer Connection Manual shall use standard DNSP equipment and configurations, as the introduction of non-standard or alternative equipment will require additional design, integration and testing between the DNSP and the Large Customer.

4.13.2 Communication Requirements Details

The DNSP has established serial RS-232 inter-connection capability method as its preferred method which can be considered for use by Large Customers.

Where the Large Customer prefers to use Internet Protocol (IP) telecommunications between the Large Customer and the DNSP Operational Technology Environment (OTE), it shall be done at layer 3 (IP) level which is controlled through an edge defence (ED) device as per Section 4.15.2 of this Standard and will incur additional costs.

Communications transmission systems are required to meet the DNSP's existing standards and not interfere with DNSP's own communication signalling. The common transmission systems utilised include optical fibre (Optical Ground Wire (OPGW) and/or All Dielectric Self Supporting (ADSS)), microwave radio systems, and power line carrier

Where duplicated differential schemes are used, there is a requirement for diverse communication paths.

4.13.3 SCADA Requirements Details

Where SCADA connectivity to the DNSP is required, the Large Customer's SCADA/control systems shall comply with the DNSP's latest standards available during the application process. The RTUs and HMI shall be the same as those used by the DNSP. The Large Customer may design the RTU connections to their plant, but the RTU configuration and programming shall be carried out by the DNSP. The HMI configuration and programming can be performed by the Large Customer but shall be done to relevant DNSP's standards and guidelines.

Appendix E – Scada and Communications Requirements (informative) sets out further requirements in relation to communications and SCADA requirements.

4.14 Data and Information

4.14.1 General

This section sets out the general information requirements to enable the DNSP to properly manage its data. Specific power systems information and data required for the connection planning study is set out in Appendix C.

In addition, where the Large Customer has been offered and elected to undertake a design, construct and transfer of Connection Assets (DCT) model (refer to our Large Customer Connection Manual for further information on Transferable Connection Assets), the Large Customer must provide the following as a precondition to the transfer of the relevant assets (subject to any further requirements set out in the Connection Agreement):

a) manuals;

b) specifications;

c) test reports;

d) design modules;

e) standards; and

f) design drawings, in respect of the relevant assets.

Data includes information on Large Customer assets, planning, environment and cultural heritage.

4.14.2 Determination of method for data delivery

At the start of a Connection Application, the DNSP and Large Customer shall liaise to determine a satisfactory way to deliver the required data specified in Section 4.14 and Appendix C (including the appropriate formats of such data and timing of delivery) and any other data reasonably required by the DNSP to achieve the critical Connection process milestones prior to commissioning, including (but not limited to) equipment details such as the relevant ratings, test results and nameplate information of the equipment.

4.14.3 Approval of designs

The Large Customer shall provide a preliminary design approved by an RPEQ, followed by updates as they become available.

All final design drawings for Connection Assets by the Large Customer shall be approved by the Large Customer’s RPEQ provided to the DNSP prior to connection.

When the project is commissioned, the “as constructed” drawings must be provided to the DNSP before the transfer of the Transferable Connection Assets to the DNSP can take place.

4.14.4 Data Prior to Commissioning

The Large Customer shall, prior to commissioning of the Connection Point, provide all required data to the DNSP.

Neither the energisation of the Connection Point, nor transfer of the Transferable Connection Asset(s), is permitted to proceed until all required data has been provided to the satisfaction of the DNSP.

The Large Customer shall provide all cultural heritage data in respect of the Transferable Connection Assets, where the DNSP will be responsible for the ongoing maintenance or operation of that asset.

4.14.5 Dynamic Data and Information

Refer to the relevant Dynamic Connection Standard for generic data requirements associated with a dynamic Connection.

The Technical Study shall further determine the information required for dynamic data and information from the Large Customer installation.

4.15 Cybersecurity

The following section applies to establishing ethernet communications between the DNSP and Large Customer that are not specific to a dedicated protection communications channel. Physical access restrictions may be implemented for DNSP owned Connection Assets in accordance with STNW3039 Network Physical Security – Design Reference.

Protection communication requirements are detailed in Appendix B.

4.15.1 Roles and Responsibilities

The DNSP may disconnect all IP traffic flows upon suspicion of malicious activities or security breaches. The DNSP and Large Customer shall keep the other party informed of any planned works and incidents on the telecommunications and Edge Defence equipment that may impact the communications link.

The Large Customer shall inform the DNSP of any cyber security breaches that may impact the operational electrical environment.

The Large Customer shall inform the DNSP of their vulnerability and risk management strategy upon knowledge of a vulnerability advisory affecting the operational electrical environment.

4.15.2 Cybersecurity Design

The DNSP shall deploy an Edge Defence device that shall be physically installed within the communications room located within the DNSP zone substation, whilst the Large Customer system shall deploy an Edge Defence device that interfaces the DNSP telecommunications network.

The telecommunications link shall be established via IPv4 Layer 3 routable session (eBGP preferred) and shall transit both Edge Defence devices, between the DNSP and Large Customer.

The DNSP and Large Customer shall allow SCADA communications between the DNSP SCADA interface point and the Large Customer SCADA interface point to facilitate the control signalling capabilities.

All IP traffic received from the Large Customer shall undergo continuous deep packet inspection, intrusion detection and protection activities, before the packet is forwarded to the final destination.

The Large Customer shall only be able to send SCADA communications to the single DNSP SCADA interface point within the zone substation.

Internet Control Message Protocol (ICMP) traffic should be allowed between Edge Defence devices to enable troubleshooting capabilities. Table 9 details the security controls related to ethernet traffic.

Table 9: Security Controls Related to Traffic Flows

Flow ID	Description	Source	Destination	Protocol	Security Controls
1	SCADA traffic	Large Customer SCADA	DNSP SCADA	DNP3	Deep packet inspection Next Generation Firewall
2	SCADA traffic	DNSP SCADA	Large Customer SCADA	DNP3	Deep packet inspection Next Generation Firewall
3	Routing	DNSP Edge Defence device	Large Customer Edge Defence device	eBGP or OSPF or EIGRP or static	Deep packet inspection Next Generation Firewall
4	Troubleshooting	Edge Defence device	Edge Defence device	ICMP	Deep packet inspection Next Generation Firewall
5	Implicit deny all	Any	Any	Any	Non approved flows alerted as possible suspicious activities

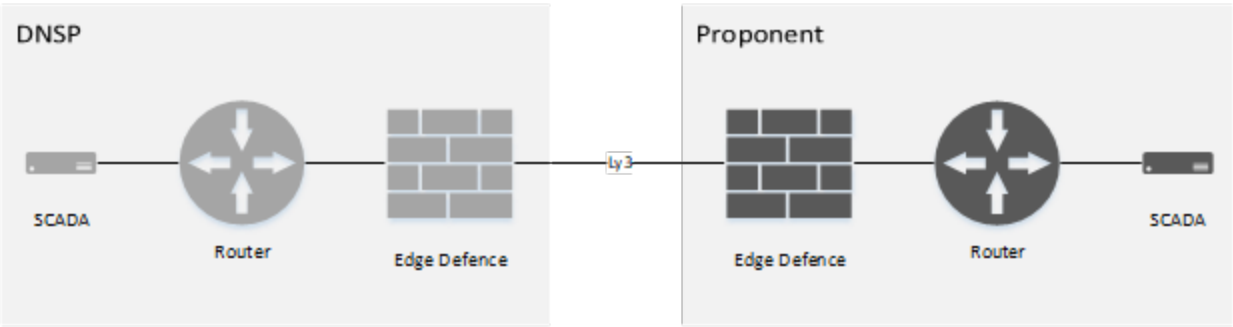


Figure 1: Information Traffic Flow Architecture Representation

4.16 Technical Studies

To connect a Large Customer's Premises, the DNSP shall undertake a technical assessment process, which includes power system modelling. These studies shall occur at the enquiry stage, as outlined in this Standard, and STNW1175 for HV EG Connections.

The Large Customer (both *load* and DER Connections) shall provide the modelling information required as set out in Technical Study and/or Connection Process.

Refer to Appendix C for data requirements.

4.16.1 Capacity Studies

As part of the Technical Study, Distribution System capacity impacts of the new or altered Connection shall be assessed to identify required augmentation, if any. This may include the development of curtailment schemes.

4.16.2 Fault Current Contribution

Fault current contribution shall be calculated, if applicable, to determine if equipment ratings are exceeded for the relevant proposed network configurations.

4.16.3 Voltage Management

Voltage management impact and required changes as a result of the new or altered Connection shall be assessed. It shall be determined whether augmentation or operational changes are required, to ensure the voltage regulation of the Distribution Network remains within required limits based on the proposed Large Customer's installation.

Large Customer Premises that have DER Systems with significant inverter-based loads and/or reactive plant shall comply with a voltage rise limit of a maximum value of 0.5% at the Connection Point over the existing voltage levels (as determined by the DNSP) prior to connection anywhere in the HV Distribution Network, due to the power export of the DER Systems, or the impact of the Large Customer's reactive plant or *load* (e.g. capacitor banks, significant cabling). As a mitigation, systems may need to operate in voltage control mode, with settings as determined as part of the Technical Study.

4.16.4 Performance Standards

For Large Customers connecting under Chapter 5A of the NER, performance standards are defined in the connections standards as applicable. For load-only customers performance standards are defined as part of the Technical Studies and are based on S5.3 of the NER as applicable.

For Large Customers connecting under rule 5.3A or rule 5.3, the performance standards under S5.2 of the NER shall be negotiated as defined in S5.3.4 of the NER.

Further information regarding the respective Connection processes can be found in our Large Customer Connection Manual.

4.16.5 Power Quality Allocation

Flicker and harmonic allocations shall be conducted as part of the Technical Study.

4.16.6 Rejection Studies

Load and/or generation rejection studies shall be conducted during the Connection process. The voltage change on any part of the Distribution System upon rejection shall be limited to:

a) In case of overvoltage and undervoltage, +/- 5%, for system normal Distribution Network configuration for all Large Customer Connections and for N-1 network configurations in;
    i. Class A2 and Class B DER Systems in Distribution Networks; and
    ii. Connections to Sub-transmission networks.

After considering the Technical Study, the DNSP may allow a larger excursion provided there would be no adverse impact on other *distribution network users*.

The overvoltage performance shall not exceed the limits prescribed in Figure S5.1a.1 in the NER.

4.16.7 Dynamic Modelling Requirements

Modelling requirements for DER Systems shall apply as per the relevant Standards such as in STNW1174, STNW1175 or STNW3511.

Loads greater than 1.5 MVA comprising of fast acting control systems, including plant such as large electric vehicle chargers, data centres incorporating uninterruptable power systems, hydrogen electrolysers, STATCOMs, static var compensators, static frequency converters or power electronic

converters or other dynamic reactive plant, may be required to provide appropriate dynamic modelling at the application stage. This will be determined and defined during the Technical Study.

Where applicable, stability studies shall be conducted in accordance with AEMO System Strength Impact Assessment Guidelines and obligations under the NER. This applies to relevant distribution connected units, Integrated Resource Providers and inverter-based loads.

4.16.8 Protection Requirements

Protection requirements shall be identified as part of the Technical Study.

4.17 Interlocking

Fail-safe interlocking mechanisms shall be required as specified in Table 10 for Premises with multiple transformers or multiple Connection Points, bumpless transfer and off-grid connections.

The table below shows the interlocking mechanisms required for different connection arrangements. It should be noted that interlocking design is not covered by a prescriptive design or standard, and as such, RPEQ design and oversight is required.

Table 10: Interlocking Requirements

Connection Arrangement	Fail-Safe Interlocking[1] Requirements
Multiple transformers or multiple Connection Points	No distribution transformers or DNSP service points are connected in parallel[2].
Bumpless transfer	During the transfer from one source to another, the interlock operation cannot enable the Generating Unit and the Distribution System to both supply the load at the same time for longer than the maximum allowable duration in the relevant DER Standards as applicable. No distribution transformers will be connected in Parallel at any point during the bumpless transfer
Off grid	During the transfer from one source to another the interlock operation cannot allow the Generating Unit and the Distribution System to both supply the *load* at the same time, for any duration.

Note 1: The interlocking mechanism should be a mechanical fail-safe system. Electronically controlled interlocking systems may be allowed after DNSP review and agreement of a proponent submitted, RPEQ certified functional design (Functional Specification) and operational specification provided in the application stage. This should be submitted for review in advance of any construction commencing. This enables any iterative amendments and corrections to be made at the design stage, thereby avoiding additional costs and delays due to need to rectify. Where Generating Unit is connected, no DNSP asset is to have their stipulated ratings exceeded.

Note 2: Large Customer's transformer cannot be connected in Parallel at LV where multiple Distribution System supplies existing. Paralleling of HV feeders may be considered subject to a technical study (Refer to section 4.6).

4.18 Load Shedding Schemes

For Large Customers with expected peak demands in excess of 10 MVA, load shedding procedures shall be applied by AEMO in accordance with the provisions of Schedule S5.3.10 of the NER for the shedding of all loads including sensitive loads.

4.19 CBD and CBD Fringe Areas

For Large Customers in CBD and CBD fringe areas (especially but not limited to: high rise residential or commercial buildings, hospitals, shopping centres), it is expected that the large customer will be supplied by multiple feeders offered by Energex or Ergon Energy Network. As such, an indoor/chamber substation room suitable for housing relay operated (remotely operated) switchgear is expected to be made available. From a size perspective, these substations have a larger footprint than other types of indoor/chamber substations. Specific requirements are (but not limited to):

- Sufficient space to house all the necessary equipment for remote operated switchgear
- Increased earthing requirements (greater fault withstand capability)
- Increased number of conduits
- Communications infrastructure

Refer to the *Joint Supply & Planning Manual* Section 8.7 and 9 for more details.

5 Testing and Commissioning

Testing and commissioning shall verify that the Large Customer's Premises:

a) Do not adversely affect the security of the Distribution System or the quality of supply of electricity through the Distribution System;

b) Comply with the agreed performance requirements referred to in the relevant Connection Agreement; and

c) Do not pose a risk of causing damage to the Distribution System, or any equipment of any other *distribution network user* that is connected to the Distribution System.

Testing and commissioning requirements shall consider the following:

i. Testing and commissioning plans shall be prepared by the Large Customer and may be required to be approved by the DNSP under the Connection Agreement;

ii. The commissioning plan and acceptance shall be carried out by an RPEQ;

iii. Testing and commissioning acceptance may require the DNSP to carry out witnessing at the Large Customer's expense;

iv. Testing shall involve installation test, not type tests; and

v. Any other requirements as set out in the Energy and Safety Laws.

6 Operations and Maintenance

6.1 General

Where applicable, such as defined in our DER Standards, or where HV-connected Large Customers own isolating devices or protection equipment; operations and maintenance requirements apply. This includes, but is not limited to:

a) An operation and maintenance manual for the relevant plant shall be produced by the Large Customer, and a copy accessible on site;

b) The Premises shall be operated and maintained to ensure compliance at all times with the Connection Agreement and all applicable legislation, codes, and/or other regulatory instruments;

c) Operation and maintenance reports may be required by the DNSP at a specified interval no more frequently than annually;

d) The electrical installation at the supply address shall be maintained in a safe and accessible condition;

e) Subject to paragraph 6.1(f) below, the Large Customer shall ensure that any changes to the electrical installation at the supply address are performed by a licensed electrical contractor lawfully permitted to do the work, complying with the design by an RPEQ and that the Large Customer holds a Certificate of Compliance issued in respect of any of the changes;

f) The Large Customer shall seek DNSP approval prior to altering the electrical connection in terms of an addition, upgrade, extension, expansion, augmentation or any other kind of alteration that is involved in the primary and secondary *plant*; and

g) The Large Customer shall notify the Distributor of any scheduled and unscheduled protection or communications outages or failures.

The DNSP may at its own cost inspect the Large Customer's LV or HV installation at any time in accordance with the terms of the relevant Connection Agreement or as otherwise permitted under the Energy and Safety Laws. The DNSP may require access to the site of the Large Customer's system and isolation points for Distribution System maintenance and testing purposes.

If the DNSP determines through an audit or an investigation that the connection is non-compliant with the requirements set out in the Connection Agreement, the DNSP shall advise the Large Customer of this in writing. If the concern has a material impact on the Distribution System, the DNSP shall disconnect the Large Customer until the non-compliance has been remediated by the Large Customer to the DNSPs satisfaction in accordance with the DNSP's rights under the Connection Agreement, Energy and Safety Laws or other legislative instrument.

6.2 HV Connections

As a requirement of the Energy and Safety Laws, Large Customers who have a high voltage electrical installation shall prepare an Installation Safety Management Plan for their workplace. The plan shall address the risks associated with the operation and maintenance of the high voltage installation.

This may include:

a) A single line diagram for the installation, showing all switches and circuit breakers and their identifying labels or numbers;

b) Site-specific operating rules covering all aspects of operating the high voltage installation, including procedures for arranging isolation of the installation from the DNSP's network;

c) Procedures for identifying hazardous areas including any confined spaces associated with the installation;

d) Competency requirements for persons who may be permitted to operate or work on the high voltage installation, including appropriate requirements for re-training, re-testing and re-accreditation;

e) Induction procedures for new contractors;

f) Regular inspection and maintenance programs to ensure the installation remains serviceable and safe;

g) Procedures for ensuring there is no extension or alteration of the installation without permission from the DNSP if the works necessitates an alteration to the Connection Agreement;

h) Procedures for the safe handling of insulating oils and other substances that may be required for maintenance or repair; and

i) Procedures including warning signs for ensuring that all parts of the high voltage installation (e.g. underground cables and high voltage overhead power lines) are not damaged by heavy vehicles or other mobile plant, for example mobile cranes.

The Large Customer shall engage the services of an Electrical Safety Office (Qld) Accredited Auditor to provide a certificate inspection and confirmation for the installation including the Installation Safety Management Plan and, operation and maintenance manual.

6.3 Operating Protocol

All HV connected Large Customers and some LV connected Large Customers (e.g. CBD high rise buildings) will be required to have an operating protocol in place between the DNSP and the Large Customer. The operating protocol will provide the basis for mutually agreed and uniform operating procedures relating to the Connection Point. Operational practices may evolve over time, and the Operating Protocol shall be updated and amended from time to time to reflect the applicable arrangements.

The Operating Protocol will be developed collaboratively by the nominated persons from the DNSP and the Large Customer and will detail:

a) Up-to-date site contact name(s) and details;

b) Site access and physical security;

c) The process for managing planned outages, outage coordination, repairs and maintenance;

d) The process for managing unplanned outages, repairs and maintenance;

e) Communications protocols;

f) Maintenance policy;

g) Auxiliary services;

h) Site operational information as relevant;

i) Information regarding protection across the Connection Point; and

j) Switching procedures.

k) Each party shall retain a copy and advise the other in case of required updates.

Appendix A Large Connection Arrangement Option (Normative)

The arrangements in Appendix A are examples of typical connection configurations and are designed to be simple diagrams to be used purely as initial concept plan only. They are not to be used as design drawings. It is expected a more detailed Single Line Diagrams (SLDs) will be developed following site-specific reviews to determine the final requirements. Note: The DNSP reserves the right to determine the most appropriate connection option.

Table 11: Connection Arrangement Option Summary

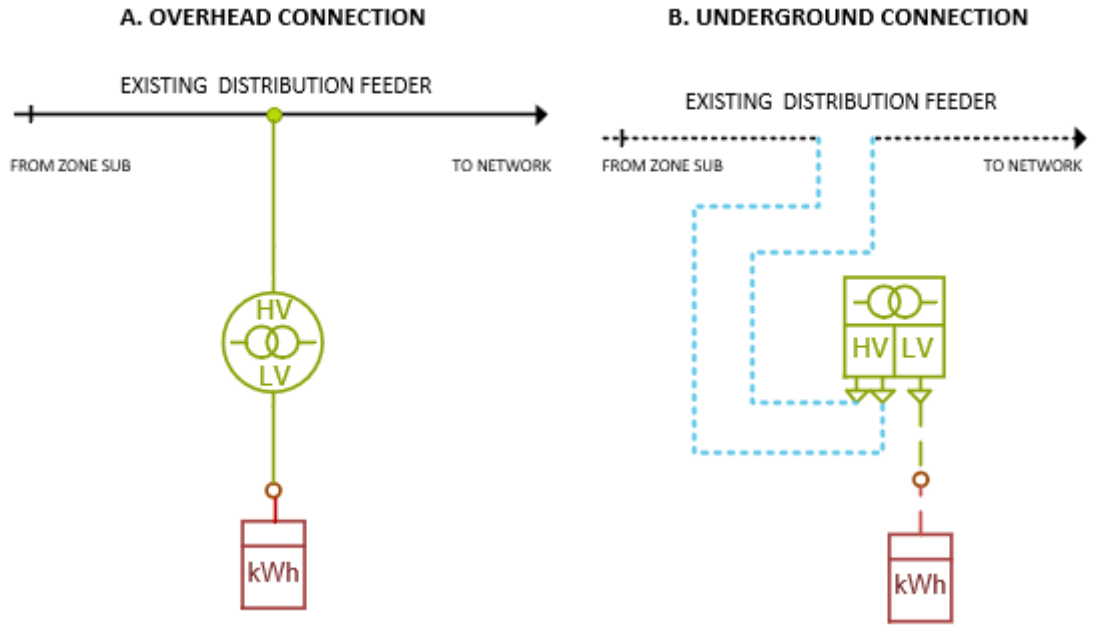
Ref	Connect voltage	Description	Connection Point	Premises capacity[1]
L.1	LV	Standard LV Connections	Customer side of the switch fuse	<1.5MVA
L.2	LV	Overhead Feeder - dual transformer Connections	Customer side of the switch fuse	>1 to 3 MVA
L.3	LV	Underground Feeder – Dual transformer connections	Customer side of the switch fuse	>1 to 3 MVA
L.4	LV	Chamber (C&I) Substation & Mesh	Customer side of the LV CB	>1 to 4.5 MVA
H.1	11-33 kV	Simple HV Connection	Customer side of the HV CB or HV RMU.	Subject to site-specific topology.
H.2	11-33 kV	Dedicated Feeder	Customer side of the ACR for OH, Distribution System side of Customer CB for UG	
H.3	11-33 kV	Dual HV Supply	Customer side of the ACRs for OH, Distribution System side of Customer CBs for UG	
H.4	11 kV	HV Mesh Connection	Customer side of the HV CB	
S.1	> 33 kV	Tee Connection	Customer side of line isolator	
S.2	> 33 kV	Dedicated Feeder	Customer side of line isolator	
S.3	> 33 kV	Switching station	Network side of line isolator	
S.4	> 33 kV	Three bay Tee	Network side of line isolator	
S.5	> 33 kV	Dual feeder high reliable alternate supply with switching substation	Customer side of line isolator	
S.6	> 33 kV	Dual feeder supply with switching substation	Customer side of line isolator	

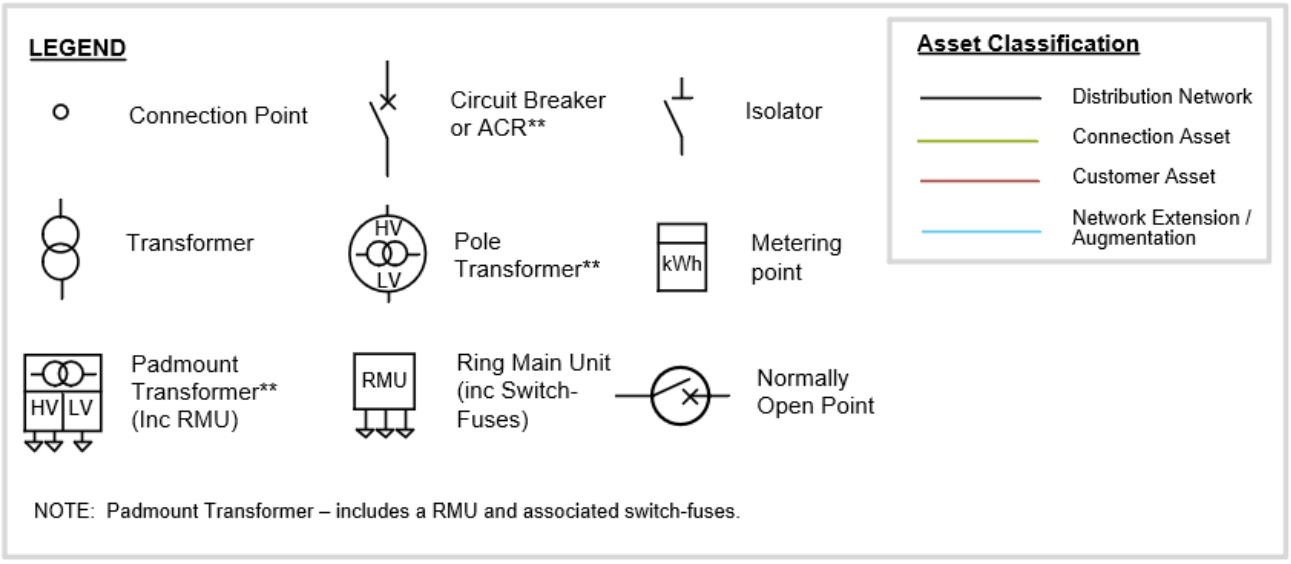
Note 1: The LV Connection capacities are based on standardised distribution transformer and switchgear capacities that may change from time to time.

NMI Allocation: NMIs shall be allocated to be consistent with the National Metering Identifier Procedure available on the AEMO website (www.aemo.com.au).

A.1 Low Voltage Connections

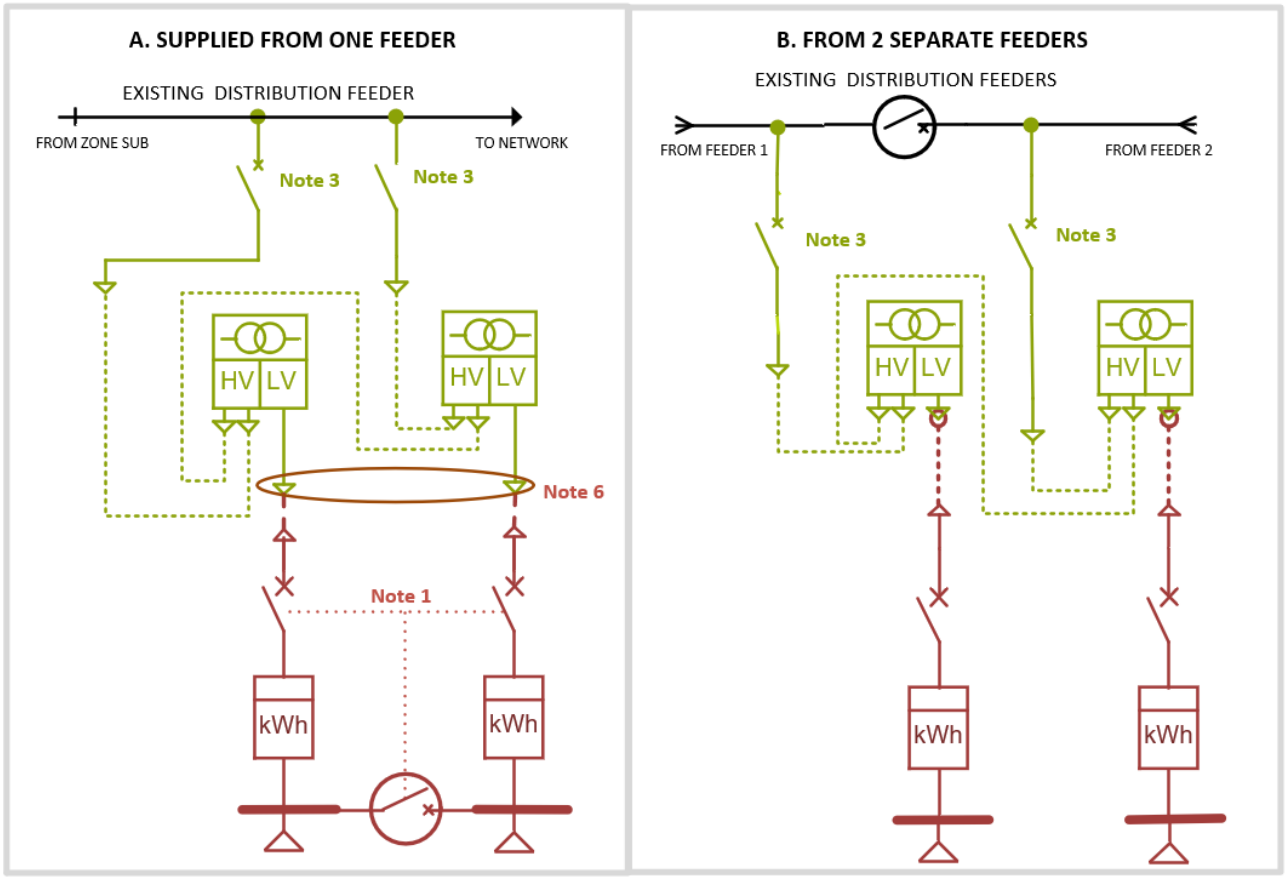
A1.1 Standard for Low Voltage Connections (DER System <1.5 MVA)





****Disclaimer** – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

A1.2 Overhead Feeder Dual Transformer Connection

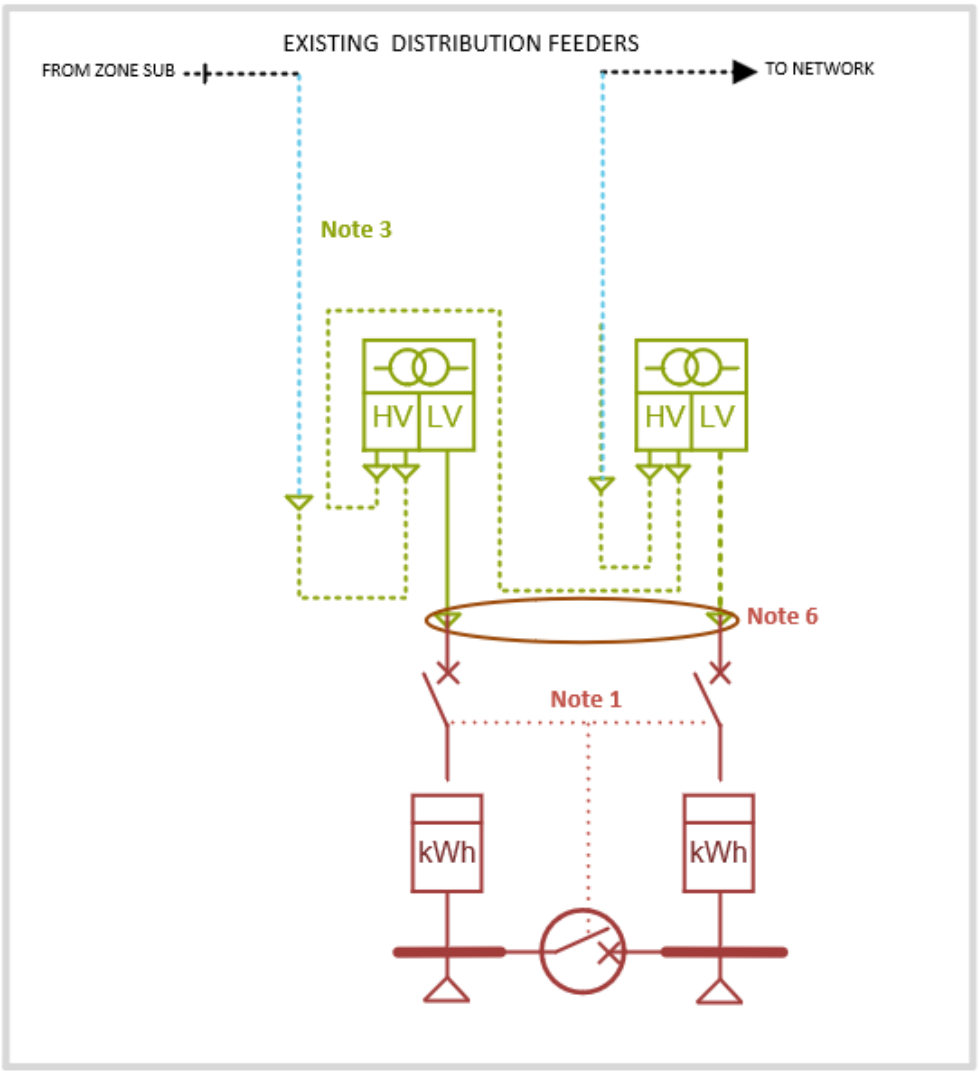


NOTES

1. The customer main switchboard (MSB) shall have an approved fail-safe interlocking mechanism to prevent parallel connection of the DNSPs distribution transformers. The interlocking mechanism shall be a manual (key based) fail-safe system.
2. A single Connection Point / single NMI is only possible where all transformers are located in the same building in the same switchroom supplying into one Large Customer LV switchboard and where supply originates form the same distribution feeder.
3. Installations with more than 1.5 MVA DER System capacity shall have a GDD installed as per 4.6.1.
4. EG systems requiring NVD protection shall require a HV VT measurement used by a DNSP relay to trip the Customer disconnection device.
5. For installations <1.5MVA of connected DER System capacity, consideration should be given to allocate space for future GDD to account for ultimate load & DER capacity when designing connection assets.in accordance with long term site needs.
6. Typical configuration for a single customer Connection Point.

Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

A1.3 Underground Feeder Dual Transformer Connection

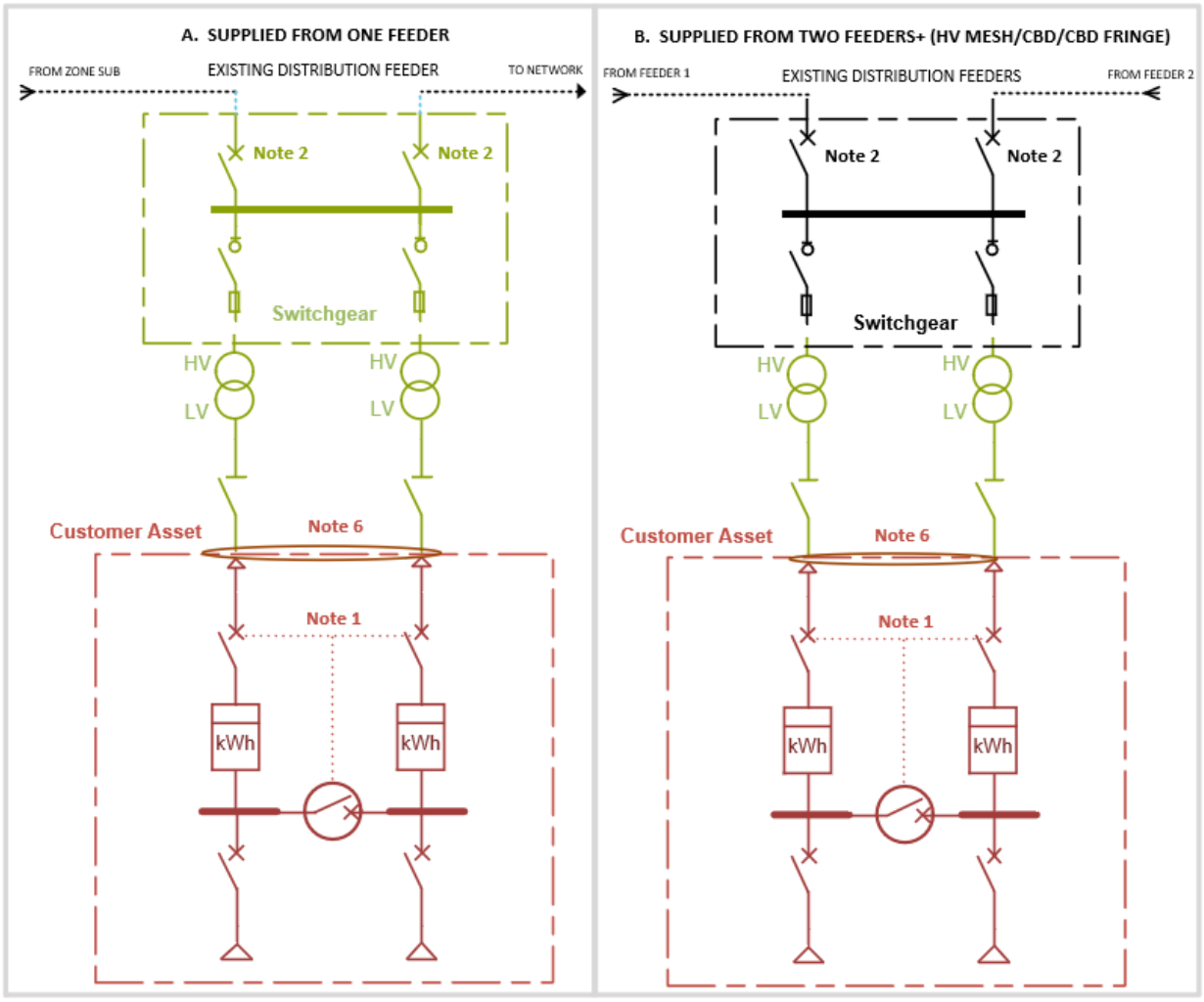


NOTES

1. The customer main switchboard (MSB) shall have an approved fail-safe interlocking mechanism to prevent parallel connection of the DNSPs distribution transformers. The interlocking mechanism shall be a manual (key based) fail-safe system.
2. A single Connection Point / single NMI is only possible where all transformers are located in the same building in the same switchroom.
3. Installations with more than 1.5 MVA DER capacity shall have a GDD installed as per 4.6.1.
4. EG systems requiring NVD protection shall require a HV VT measurement used by a DNSP relay to trip the Customer disconnection device.
5. For installations <1.5MVA of connected DER capacity, consideration should be given to allocate space for future GDD to account for ultimate load & DER capacity when designing connection assets.in accordance with long term site needs.
6. Typical configuration for a single customer Connection Point.

Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

A1.4 Low Voltage Connection - Chamber (C&I) Substation & Mesh



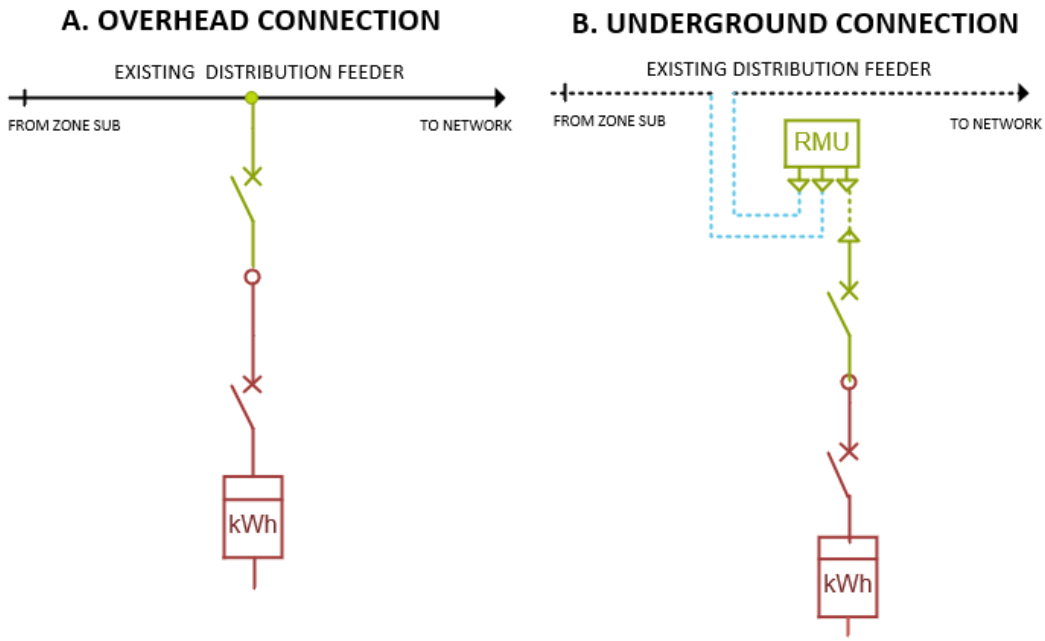
NOTES

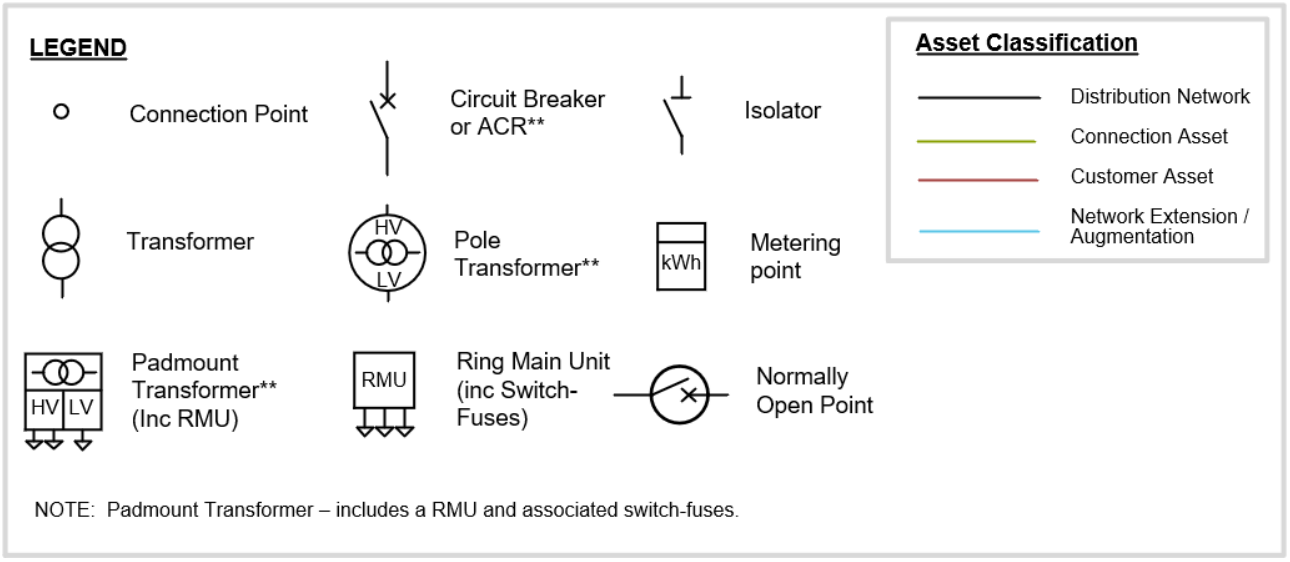
1. The customer main switchboard (MSB) shall have an approved fail-safe interlocking mechanism to prevent parallel connection of the DNSPs distribution transformers. The interlocking mechanism shall be a manual (key based) fail-safe system.
2. GDD(s) shall be installed where:
   - Large customers are connecting to part of a HV Mesh network (CBD, CBD Fringe area, refer to 4.1.9) or,
   - Installations with more than 1.5 MVA DER capacity shall have a GDD installed as per 4.6.1.
3. For installations <1.5MVA of connected DER capacity, consideration should be given to allocate space for future GDD to account for ultimate load & DER capacity when designing connection assets.in accordance with long term site needs.
4. DER systems requiring NVD protection shall require a HV VT measurement used by a DNSP relay to trip the Customer disconnection device.
5. An LV switchboard may be built to facilitate CMEN and streetlight circuits.
6. A single Connection Point / single NMI is only possible where all transformers are located in the same switchroom supplying one Large Customer LV switchboard.

Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

A.2 High Voltage Connections (Distribution)

A2.1 Simple HV Connection



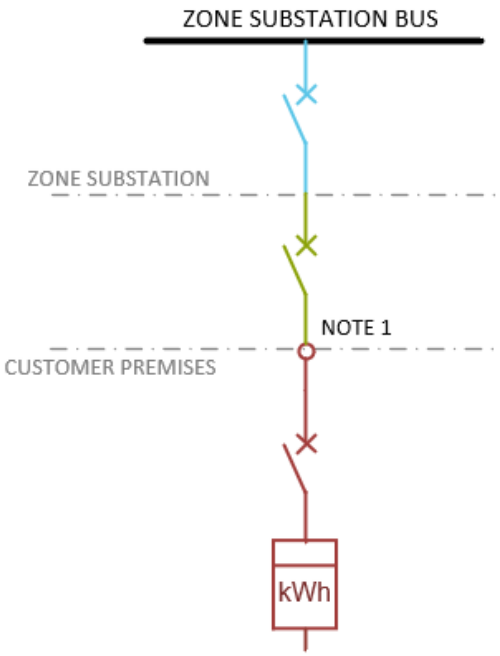


NOTES

1. By default, for a HV connection, a DNSP owned GDD is typically required at the Connection Point. It will be the DNSPs discretion if a DNSP owned GDD is not required. Refer to 4.6.1 & 4.10.
2. Considerations should be given to allocating space for GDD in accordance with long term site needs.
3. Connection assets shown are dedicated connection assets.
4. A Downsteam recloser may be required for DER Systems connections if identified through Technical Study.

Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

A2.2 Dedicated HV Connection



NOTES

1. By default, for a HV connection, a DNSP owned GDD is typically required at the connection point. It will at the DNSPs discretion if a DNSP owned GDD is not required. Refer to 4.6.1 & 4.10 for more details.

2. A Downstream recloser may be required for DER Connections if identfied through Technical Study.

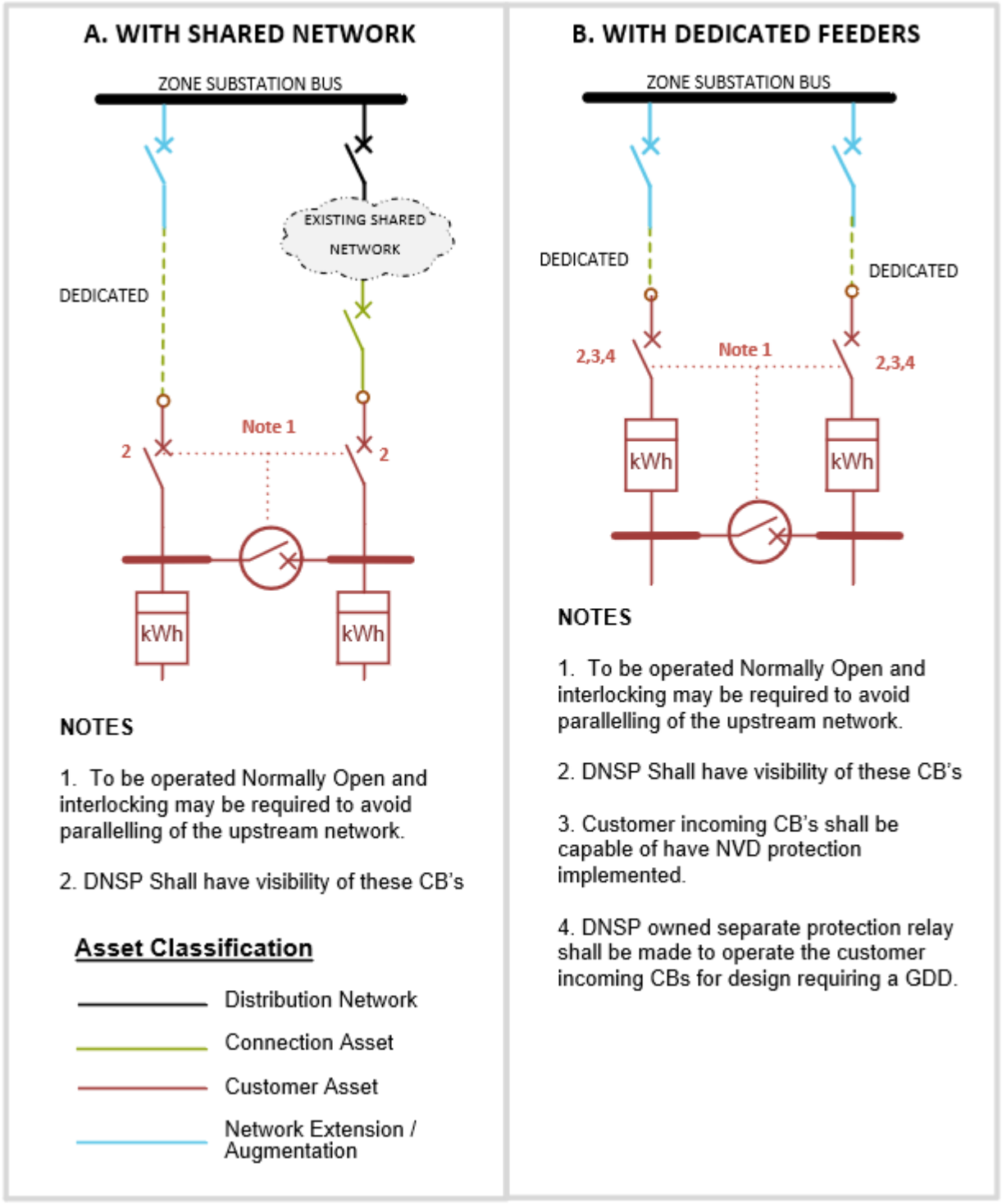
3. Connection Assets shown are dedicated Connection Assets.

Asset Classification

- Distribution Network
- Connection Asset
- Customer Asset
- Network Extension / Augmentation

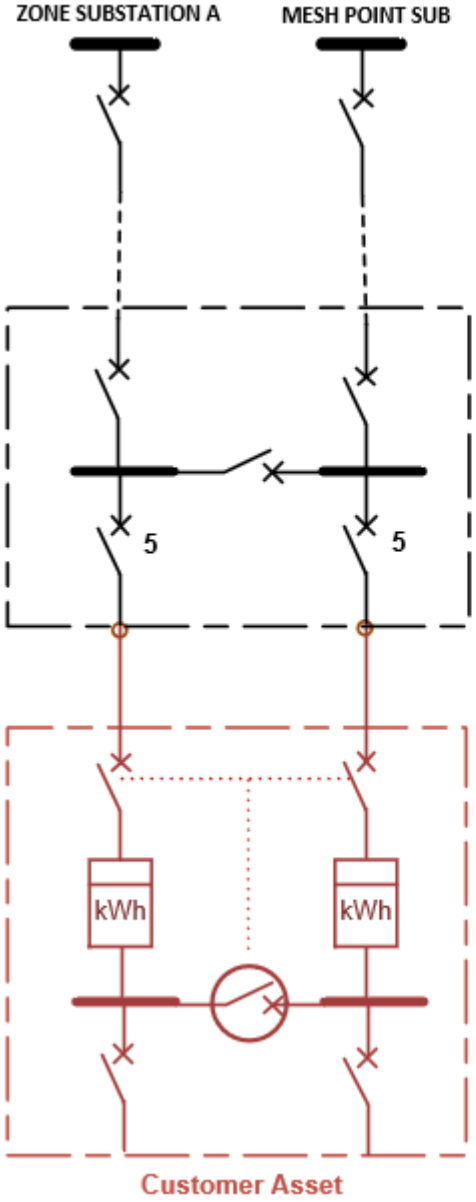
Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

A2.3 Dual HV Supply



Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

A2.4 HV Mesh Connection (2 Feeder Mesh Shown)



NOTES

1. For Large Customers in CBD and CBD Fringe areas, it is expected that the customer will be supplied by multiple feeders offered by EQL. An indoor/chamber substation room suitable for housing relay operated (remotely operated) switchgear is expected to be made available.

2. EG systems requiring NVD protection shall require a HV VT measurement used by a DNSP relay to trip the Customer disconnection device.

3. HV proposed where there are no intended shared connections to supply non-contestable LV customers.

4. An LV switchboard may be built to facilitate CMEN and streetlight circuits.

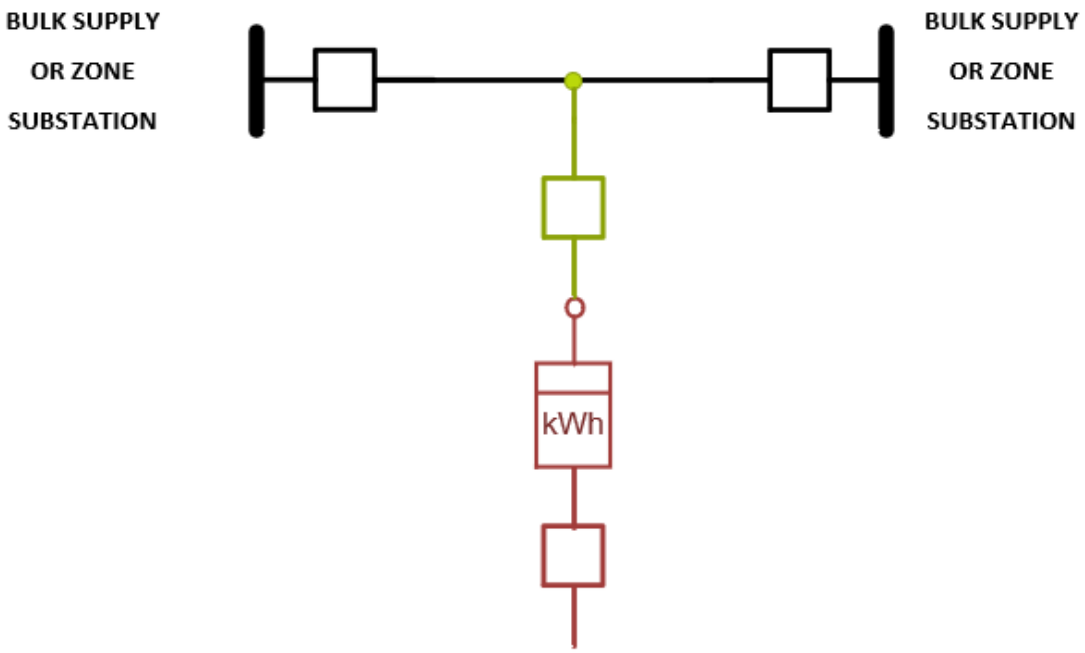
5. GDD are to be installed where:
a. Large customer are connecting to part of a HV Mesh network (CBD, CBD Fringe area, refer to 4.1.9) or
b) Installations with more than 1.5 MVA DER capacity refer to 4.6.1.

Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

A.3 Sub-Transmission Network Connections

The decision as to whether the expansion of existing DNSP substation facilities or the establishment of an additional new substation shall be based on alignment with DNSP operational and network planning requirements and demonstrated cost effectiveness over the lifecycle of the installation. As such, not all connection topologies will be available for every connection. This will be further advised during the enquiry stage.

A3.1 Sub-Transmission - "T" Connection



LEGEND

- Connection Point
- kWh — Metering point
- Substation bay

Asset Classification

- Distribution Network
- Connection Asset
- Customer Asset

NOTES

The DNSP shall own the T-substation primary and secondary plant for all Major Customer types.

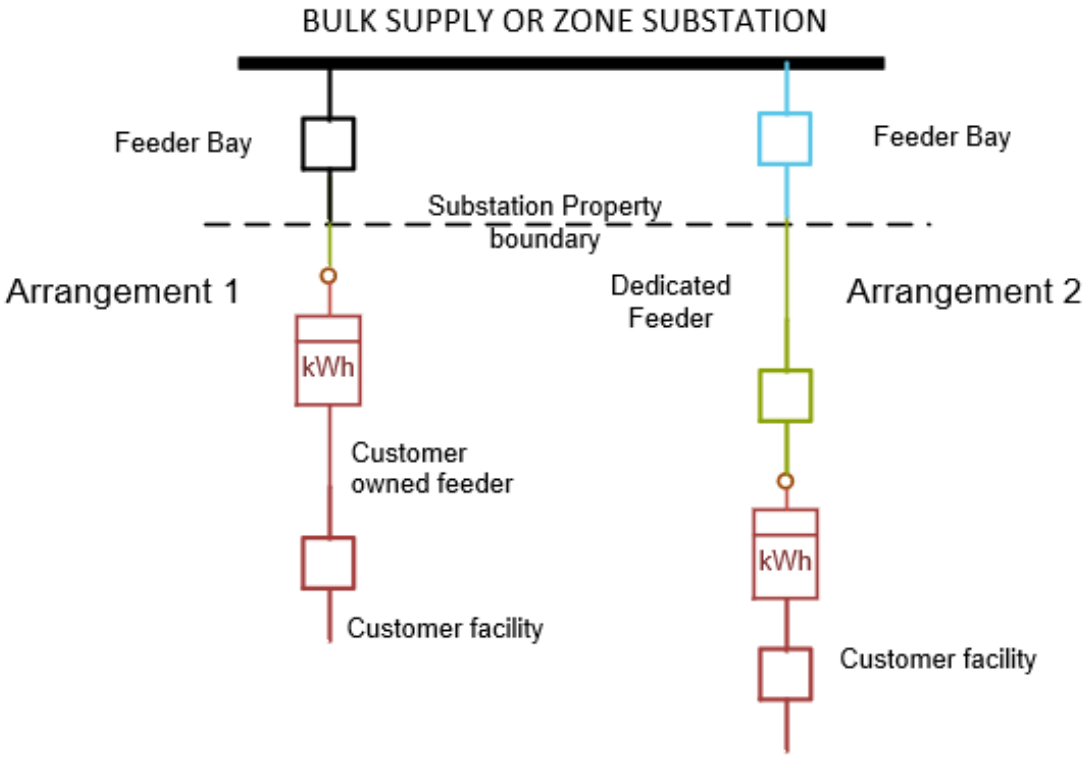
Addition of generation may increase protection and communications requirements.

Installations with more than 1.5 MVA EG capacity shall have a GDD installed as per 4.6.1. Consideration should be given to GDD space provision for long term site needs.

Substation Bay includes all ancillary equipment requires for switching (including isolators, etc)

Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details

A3.2 Sub-Transmission - Dedicated Connection



LEGEND

- Connection Point
- kWh — Metering point
- Substation bay

Asset Classification

- Distribution Network
- Connection Asset
- Customer Asset
- Network Extension / Augmentation

NOTES

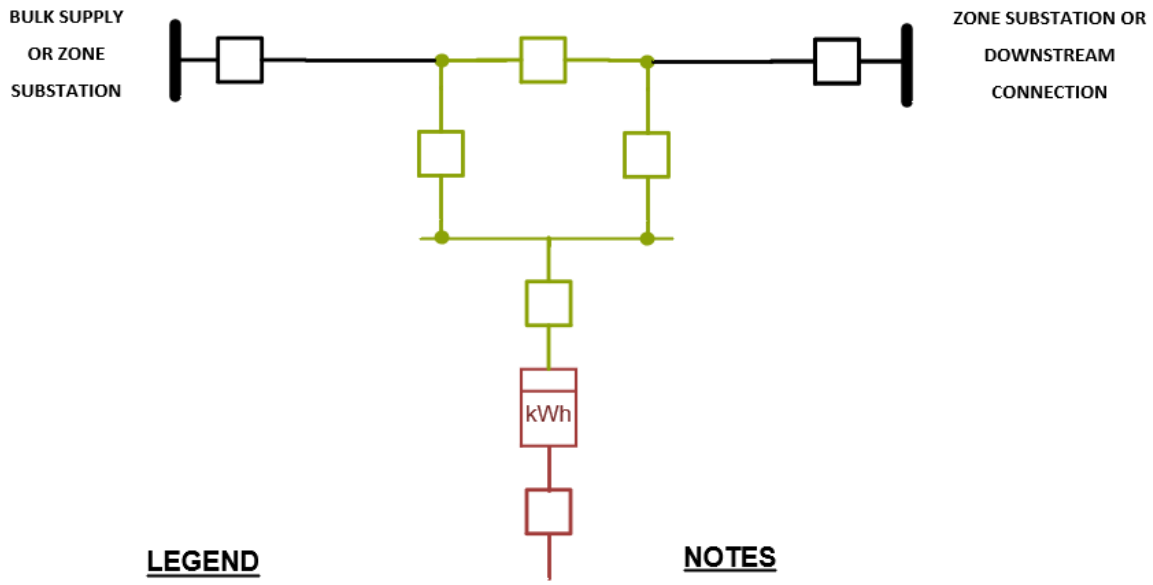
Arrangement 1 shows a Large Customer owned feeder. Protection scheme elements at customers end can be either Large Customer or DNSP owned.

Arrangement 2 shows an DNSP owned feeder. Secondary protection scheme elements (protection relays and associated communications equipment) at Large Customers end shall be owned by the DNSP. Other elements of the Protection Scheme (circuit breakers, CT, VT, DC supplies, etc.) can be either Major Customer or DNSP..

Substation Bay includes all ancillary equipment requires for switching (including isolators, etc)

Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

A3.3 Sub-Transmission Connection via Switching Station



LEGEND

- Connection Point
- kWh — Metering point
- Substation bay

Asset Classification

- Distribution Network
- Connection Asset
- Customer Asset

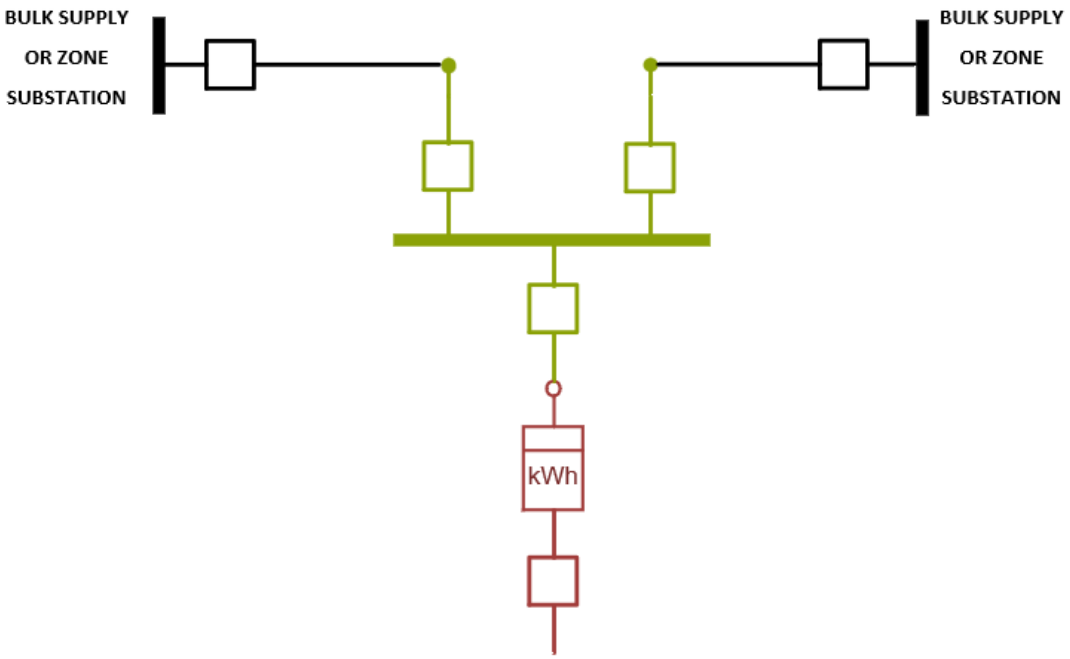
NOTES

The DNSP shall own the switching substation.
This arrangement is used to cut into radial lines where power flows are uni-directional.
This arrangement would be required based on the Large Customers need for high reliability (compared to T-substation or 3 bay tee), etc.

Substation Bay includes all ancillary equipment requires for switching (including isolators, etc)

Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

A3.4 Sub-Transmission Connection – Three Bay Tee



LEGEND

Connection Point

kWh Metering point

Substation bay

Asset Classification

Distribution Network

Connection Asset

Customer Asset

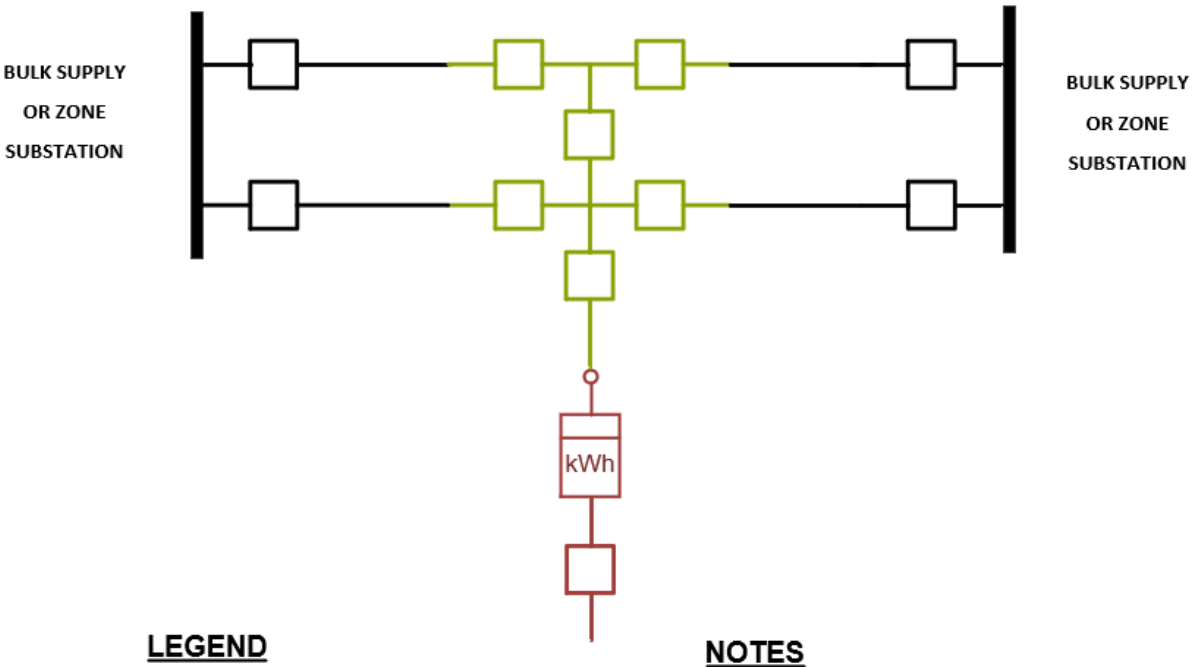
NOTES

The DNSP shall own the switching substation. This arrangement shall only be used on a ring network where all supply scenarios can be maintained from either existing DNSP substation.
This arrangement would be required based on the Large Customers need for high reliability (compared to T-substation), etc.

Substation Bay includes all ancillary equipment requires for switching (including isolators, etc)

Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

A3.5 Sub-Transmission Connection via Dual Feeders – Option 1



LEGEND

- Connection Point
- kWh — Metering point
- Substation bay

NOTES

The DNSP shall own the switching substation.
This arrangement would be required based on the Large Customers need for capacity or reliability (compared to a dual T).

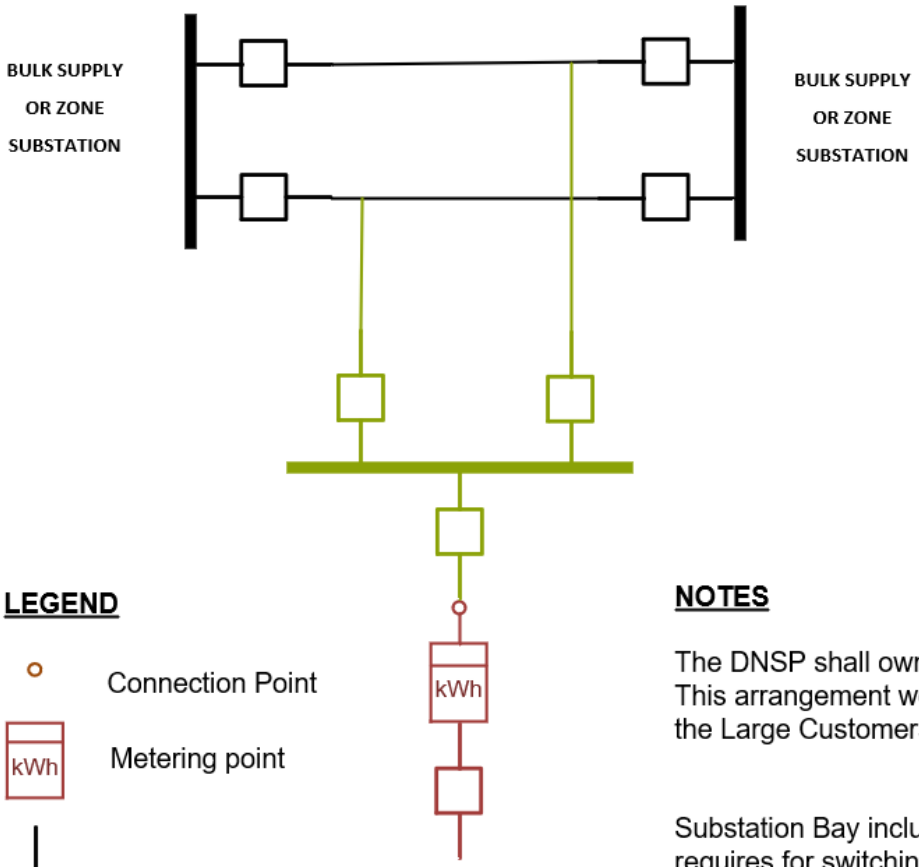
Substation Bay includes all ancillary equipment requires for switching (including isolators, etc)

Asset Classification

- Distribution Network
- Connection Asset
- Customer Asset

Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

A3.6 Sub-Transmission Connection via Dual Feeders – Option 2



LEGEND

- Connection Point
- kWh — Metering point
- Substation bay

Asset Classification

- Distribution Network
- Connection Asset
- Customer Asset

NOTES

The DNSP shall own the switching substation. This arrangement would be required based on the Large Customers need for high capacity.

Substation Bay includes all ancillary equipment requires for switching (including isolators, etc)

Disclaimer – Plant items displayed here may not show all ancillary items associated with the plant such as iso-links and fuses - as multiple configurations exist depending on the situation and design requirements. Please refer to the relevant construction manuals for further details.

Appendix B Protection and Communication Design Requirements (Normative)

B.1 General

A number of standard options have been developed to streamline the Large Customer Connection process, facilitate compliance with expected requirements and maintain distribution network reliability at compliant levels.

Connections with distribution connected generating units shall refer to the relevant DNSP's DER Standards for requirements.

B1.1 Protection Scheme Arrangements

Protection Scheme arrangements will be determined with respect to (but not limited to);

- Nature of Connection - load and/or generation,
- Line voltage,
- Proximity of the new connection with respect to the existing DNSP substation, and
- Proximity of the customer to the new substation.

Clearing times are defined by Table S5.1a.2 in the NER. Redundancy requirements are defined by Clause S5.1.9(d) of the NER.

B.2 Distribution

Note: these diagrams are simplified to articulate Protection Scheme arrangements only.

Option 1: Over Current Feeder Management

This involves a dedicated feeder bay emanating from a zone substation for a radial *load* of 4 MVA and above for voltages 22/11 kV and involves:

At the DNSP end, a feeder management relay or relays depending upon the level of available back-up protection to meet NER requirements. Relay/s as per DNSP's current relay period contract.

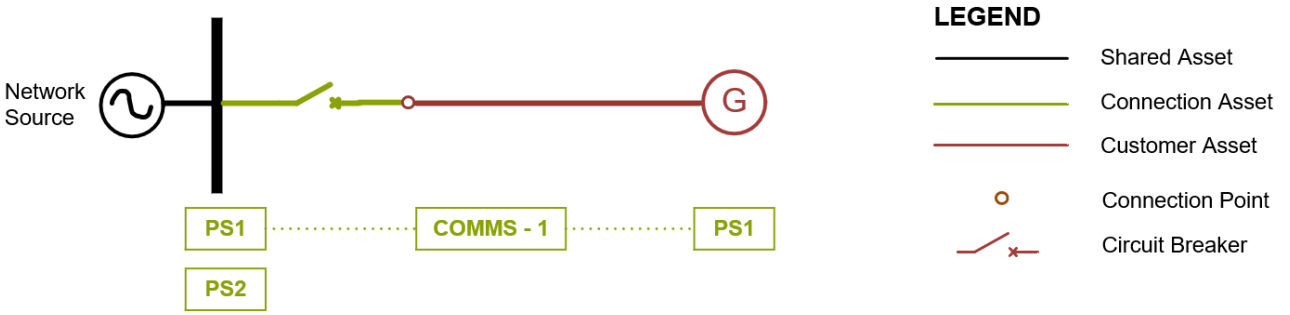
PS – Overcurrent feeder management for a radial load of >4MVA (for voltages 11/22kV)

Additional protection requirements may apply according to the relevant DNSP's relevant DER Standards if distribution connected generating unit(s) are present at the Connection Point.

Option 2: Line Differential & Feeder Management

This involves a dedicated feeder bay emanating from a zone substation for all Generation applications of 4 MVA and above for voltages 22/11 kV and involves:

- At the DNSP end, a line differential Protection Scheme and a feeder management relay, relays as per current relay period contract with a compatible line differential relay at the remote Large Customer end; and
- Protection communications suitable for line differential protection communications is required.



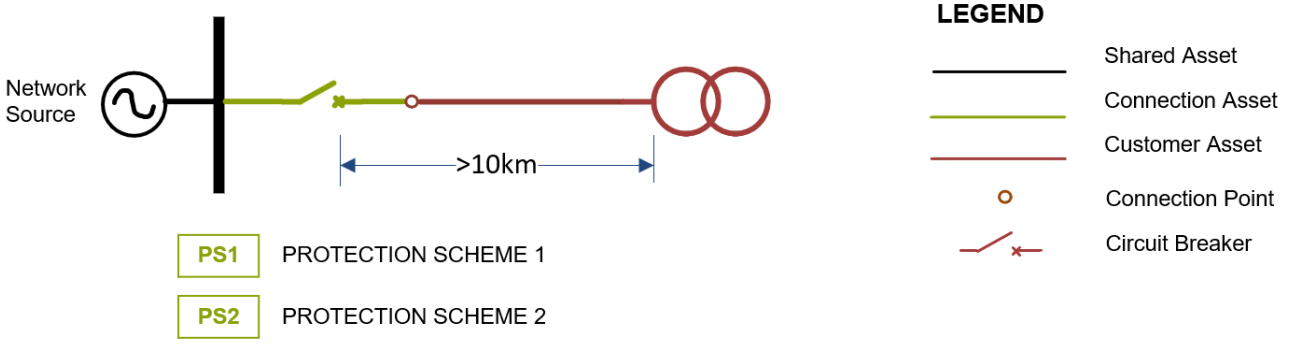
PS1 – Line differential protection & comms
PS2 – Overcurrent feeder management relays
(All generation application of >4MVA for voltages 11/22kV)

B.3 Transmission / Sub-transmission

Option 3: Distance Protection – No communications

This involves a dedicated feeder bay emanating from a zone substation with only radial *load* and a line length greater than ~10 km for voltages 132/110/66/33 kV, and involves:

- At the DNSP end, two distance Protection Schemes, with relays as per current relay period contract;
- Protection communications are not mandatory for this option, unless required to meet NER clearing times. Additionally, other customer communication requirements may need to be provided.

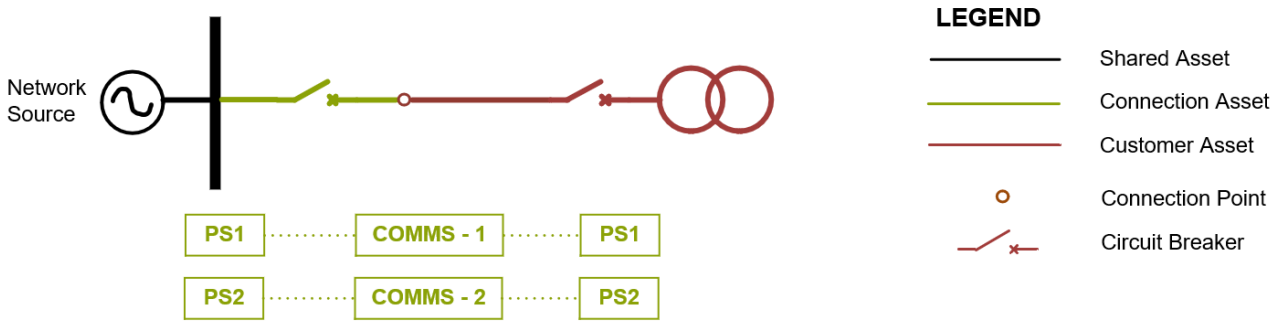


PS1& PS2 – Distance – No comms (Line Length >10km, for voltages 220/132/66/33kV)

Option 4: Line Differential Protection + Communications (Radial Load Only)

This involves a dedicated feeder bay emanating from a zone substation with only radial *load* and line length less than 10 km for voltages 132/110/66/33kV and involves:

- At the DNSP end, two line differential Protection Schemes, relays as per current relay period contract, with compatible relays at the remote Large Customer end; and
- Protection communications shall be suitable for line differential protection communications, duplicated and diverse paths shall be provided for 220/132/110 kV applications in order to meet NER clearing times. 66/33 kV applications may have an alternative scheme negotiated.

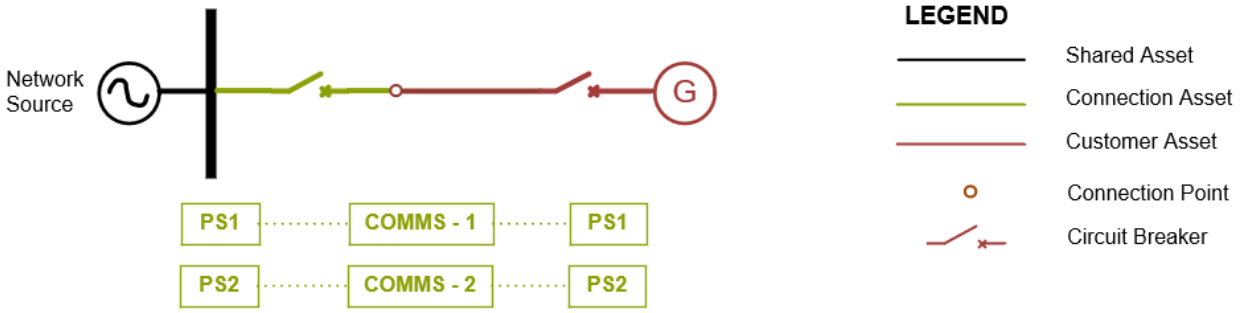


PS1& PS2 – Line differential protection & comms (for voltages 220/132/110/66/33kV)

Option 5: Line Differential Protection + Communications (Generation)

This involves a dedicated feeder bay emanating from a zone substation for all generation applications for voltages 220/132/110/66/33 kV and involves:

- At the DNSP end, two line differential Protection Schemes, relays as per current relay period contract, with compatible relays at the remote Large Customer end; and
- Protection communications shall be suitable for line differential protection communications and duplicated and diverse paths shall be provided.



PS1& PS2 – Line differential protection & comms (all generation applications for voltages 220/132/110/66/33kV)

B.4 Switching Stations

Option 6: Intermediate Switching Station - Radial Feeder

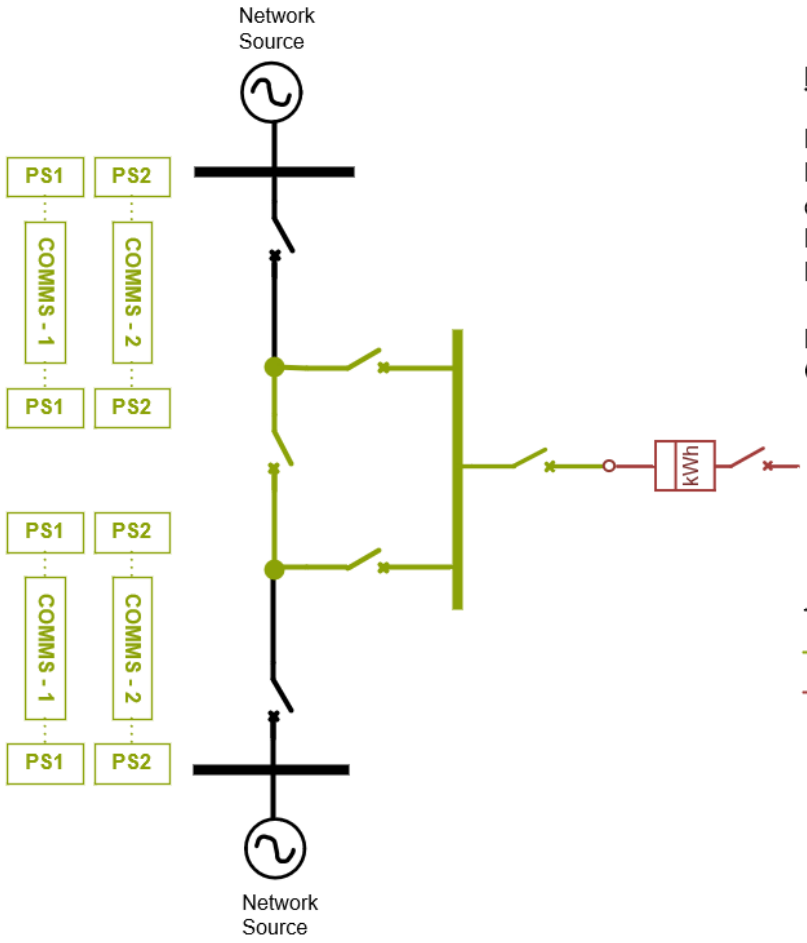
If an intermediate switching station is to be established on a radial feeder to facilitate a Large Customer Connection, the interconnector to the switching station is to be developed in line with Option 7 and the associated sketch, and the dedicated bay to the Connection Point (and the new feeder if created by the sectioning) shall be considered against Options 1-5 above. If the existing protection is not capable of providing the required functionality, a remote upstream protection upgrade shall be required in these instances to facilitate the Large Customer Connection.

Option 7: Intermediate Switching Station

If an intermediate switching station is to be established between two existing zone substations to facilitate a Large Customer Connection, then each inter-connector to the switching station shall require either duplicated line differential or line differential and distance protection in permissive over-reach mode (POR) and the further dedicated bay to the Connection Point shall be considered against Options 1-5 above.

Protection communications suitable for the combination of line differential and/or POR (permissive over-reach) schemes shall be required. If the existing protection is not capable of providing the required functionality, remote upstream protection upgrade shall be required in these instances to facilitate the Large Customer Connection.

The Large Customer is required to fund the costs of establishing new communications links and additional or replacement protection relays.



NOTES

PS1 and PS2 –
Duplicate line differential protection
or
Line differential and distance in Permissive overreach mode (POR).

Protection on customer feeder as per Option 1-4.

LEGEND

- Shared Asset
- Connection Asset
- Customer Asset
- Connection Point
- Circuit Breaker
- Isolator
- Metering point (kWh)

Appendix C Data and Information (Informative)

Data and information shall be provided by the Large Customer to the DNSP based on the application type and may include some of the following below (but not limited to):

The Large Customer shall provide the DNSP with technical details of:

a) The impedances of the Premises Network including cables, lines, transformers, etc.

b) Secondary equipment such as control equipment, voltage regulators, STATCOMs and power factor correction equipment;

c) Plant that can contribute to the fault current in the Distribution Network such as chillers, motors and generating units; and

d) DER System static data and information requirements, as referred to in the relevant DER Standards.

C.1 Format for Designs

All designs submitted to the DNSP shall be in an electronic format suitable both for direct printing of drawings and in a CAD format suitable for transfer to GIS and drawing management systems. The files provided shall include:

i. Adobe PDF format with a paper size to suit CAD files title block; and

ii. Line designs where required shall be in CAD format readable and to data specification using the DNSP's External Design Tool (AutoCAD) that will allow electronic loading directly into the DNSP's GIS, without further requirement for manual intervention; and

iii. Substation designs shall be in CAD format readable by DNSP preferred Design Tool or AutoCAD and be compliant with DNSP's design specifications.

C.2 Use of AutoCAD and Relevant Numbering Requirements

The Large Customer shall provide a single line diagram and design information to the DNSP's relevant design group through the DNSP's Large Customer Sponsor at the earliest opportunity.

The Large Customer shall obtain the relevant numbering requirements from the DNSP's relevant design group.

The Large Customer shall deliver all line designs compatible with the DNSP's external design tool (AutoCAD).

Appendix D Works Classification and Construction Options (Normative)

D.1 Construction and Ownership Options

There are broadly two "default" options which can be used for the construction and ownership of Connection Assets required for a Large Customer Connection connecting to the Distribution Network. These options are clarified in the Table below.

Table 12: Construction and Ownership Options for Connection Assets

Option	Acronym	Explanation
Option 1 Large Customer designs and constructs the Connection Assets and then transfers these to the DNSP.	DCT	This involves the Large Customer carrying out the design and construction of some or all of what will be their Connection Assets at its expense, and upon acceptable completion, transferring some or all of those assets (namely, the Transferable Assets) to the DNSP. Upon transfer, the DNSP will be responsible for the ongoing maintenance and operation of the Transferable Connection Assets (any non-transferred assets remain the responsibility of the Large Customer). Any Transferable Connection Assets must comply with the DNSP's standards and guidelines, as well as all planning, environmental and cultural heritage laws and approvals, and be constructed using approved equipment and contractors (where specified). Auditing obligations will be imposed on the Large Customer under the Negotiated Connection Establishment Contract. Additionally, the DNSP will inspect and audit works to ensure that they are designed, constructed and installed to comply with the DNSP's standards and guidelines. The use of approved equipment and contractors assists in maintaining common spare parts and standardising product training for the DNSP employees so that costs and the duration of outages caused by any failure of such Transferable Connection Assets can be minimised. Any ACS works being done by the DNSP will be recovered up-front from the Large Customer, and the cost of any SCS will be recovered by the DNSP as part of the ongoing network charges.
Option 2 The DNSP designs, constructs, owns and operates the Connection Assets.	DNSP BOO	This involves the DNSP carrying out the design and construction for the Large Customer's Connection Assets as an ACS, including obtaining all required environmental and planning approvals. The DNSP will be responsible for the ongoing maintenance and operation of these assets. The AER-approved formula is used by the DNSP to determine the cost to the Large Customer calculated at the time the relevant service is performed. The cost of any SCS will be recovered by the DNSP as part of the ongoing network charges.

D.1.1 Testing and Commissioning for the DCT Options

The Large Customer shall, prior to commissioning of any of its Connection Assets, give the DNSP a copy of an HV audit certificate for relevant HV assets that is supplied by an appropriately accredited and authorised auditor.

The Connection Applicant/Service Provider shall ensure that all electrical and mechanical tests are performed in accordance with the appropriate regulations and standards. Pre-commissioning tests on certain equipment may be required. These tests will be listed in the testing program.

The DNSP will need to be satisfied that all HV equipment, control and protection equipment, auxiliary supplies and earthing requirements are in compliance with specific manufacturer's requirements and/or its own internal operational and maintenance requirements. This will be done through the appropriate party carrying out relevant tests, and where the appropriate party is not the DNSP, the DNSP will usually need to witness the relevant tests.

In addition, the DNSP will not energise the Connection Point or connect any HV equipment until it is satisfied that the Large Customer has met certain requirements set out in the NOCC (such as provision of required Securities etc.).

D.2 Construction Options (Informative)

Table 13: Construction Options (Typical)

Asset Category	Works to supply Connection Applicant	DCT available Energex	DCT available Ergon Energy
Bulk Supply or Zone Substation	New assets or augmentation of existing assets e.g. switchgear, transformers that is not dedicated	No	No
	New assets or augmentation of existing assets e.g. switchgear, transformers that is dedicated	No	No
Dedicated Substation assets located outside DNSP property/ substation or switchyard 33kV and over.	New assets, e.g. feeder bay, transformer bay	No	Yes, subject to risk assessment
HV Feeders or sections of HV feeder (11kV to 132kV)	New feeder or augmentation of existing feeder where feeder is expected to supply customers other than the Connection Applicant identified in the planning horizon forward plan. Examples: HV feeder will form part of the Network supplying other customers. Overhead construction with multiple circuits where at least one circuit is supplying other customers. Underground construction with multiple conduits or circuits where at least one circuit supplying other customers.	No	No
	Removal of a constraint to supply a Generator or Integrated Resource Provider	No	No
	Augmentation of the Distribution Network to facilitate greater reliability than defined by the Distribution Authority	No	No

Asset Category	Works to supply Connection Applicant	DCT available Energex	DCT available Ergon Energy
	New feeder or section of feeder is dedicated to connecting the Connection Applicants only – Excludes augmentation and relocation and not identified in the planning horizon forward plan	Yes	Yes
Distribution Substations on Connection Applicant's Premises or Development Site[2] (LV, 11kV, 22kV or 33kV)	Transformers and LV switchgear supplying Connection Applicant's facilities at the site only.	Yes	Yes
	HV cables and HV switchgear at the site where Connection arrangement involves: A single "loop in / loop out" HV cable Connection to the Distribution Network, and No protection relay controlled HV network switchgear is involved.	Yes	Yes
	HV Cables and HV switchgear at the site where Connection arrangement involves more than a single "loop in / loop out" Connection to the Distribution Network.	No	No
	Protection relay controlled HV network switchgear.	No	No
Dedicated secondary systems	Communication/ protection assets that are solely used by the Large Customer.	Yes	Yes
Shared Secondary systems	Shared communication and or protection asset.	No	No
Customer's Assets	Downstream of the Connection Point.	At Large Customer's discretion.	At Large Customer's discretion.
Metering	Dedicated to Large Customer, usually located adjacent to Connection Point.	Retailer or Large Customer to appoint Metering Provider	Retailer or Large Customer to appoint Metering Provider

[2] *A development site may comprise one or more Registered Property Lots.*

Appendix E SCADA and Communication Requirements (Informative)

Information set out below is generic only and intended to be indicative only. Actual arrangements and requirements may vary due to the connection type, advancement in technology, or cyber security requirements.

E.1 Time Stamp Data and Sequence of Events

DNSP requires sequence of event data from customer plant, where the plant is a power system element such as circuit breakers, Distribution connected generating unit and protection trips. This data shall be time stamped at the first collection device.

Where customer data does not fall into this category, it may be acceptable to transmit any data required by DNSP over protocols that do not support timestamping.

E.2 DNSP Control Systems Hardware

DNSP is currently standardised on DNP3 SCADA protocol. The current SCADA Outstations support:

Slave: DNP3 Level 2 (Request & Response)

Master: DNP3 Level 1 (Requests) and Level 2 (Response)

Further details are provided below in E.6.

E.3 Minimum Customer SCADA Requirement

The Large Customer SCADA shall have a minimum requirement of supporting:

Slave: DNP3 Level 1

With the following additions: SOE Timestamping

E.4 Other SCADA Protocols

Other SCADA protocols may be considered on request by the Large Customer. The request should take into account any requirements due to time stamping.

E.5 Communications Link

Multiple data links may be required for operational purposes as per the table below.

Table 14: Date Links

Master	Slave	Type	Comment
DNSP	Customer	Serial/ Ethernet	Transmit Ramp Down commands Receive Generation unit status and analogues
Customer	DNSP	Ethernet	Optional: customer receives DNSP status and analogues

Where serial communication is utilised, configuration as per Table 15 applies.

Table 15:Serial Configuration

Setting	Configuration	Comment
Type	Serial	
Baud	9600/ 19200	Higher speed on request
Data Bits	8	
Parity	N	
Stop Bits	1	
Flow Control	Off	

E.6 SCADA Protocol & Configuration

DNSP currently uses DNP3 as standard Outstation to Master station protocol. The tables below detail suggested scan rates, configuration and functions DNSP supports as standard. The DNSP standard addressing has been provided below in Table 16. Please advise customer Master and Slave DNP addressing.

Time synchronisation for the connected customer device is required. This may be provided by the Large Customer's own clock (e.g. GPS) or may be provided from the DNSP RTU (Stratum-3) through DNP3 time sync commands, synchronised from the DNSP GPS clocks.

Table 16: Example DNP3 Unit Addressing

Link	Master	DNP3 Address	Slave	DNP3 Address
1	Ergon	0	Customer	1

The following Table 17 defines timing and buffer size for DNP3 object class scans. Where a report by exception is utilised, the buffers may be set smaller (default: 1) to send data immediately upon change. Retries and timeouts parameters as per Table 18 apply.

Table 17: Scan Rates & Buffers

Class Scan	Binary Indications	Analog Indications	Time (s)	Buffer Size
0	Integrity poll with flags	Integrity poll with flags	3600	-
1	Event poll with flags and Time	-	2	1000
2	-	Event poll with flags and time	3	60000

3	Unused	Unused	-	-

Table 18: Retries, Timeouts

Type	Retries/Timeouts (ms)
App Layer Retries	0
App Layer Timeouts	7000
Link Layer Retries	0
Link Layer Timeouts	2000
Confirmation Timeouts	8000
Response Timeouts	9000
In Scan Timeouts	0

Table 19: DNP3 Functions / Internal Indications

Type	Versions	Supported/Comment
Secure Authentication	V2, V5	Not Supported
SOE Time Stamping	-	Yes, Enabled by default, Millisecond SOE Timestamp
Time Synchronisation	-	Yes, DNSP RTU synced from DNSP OCC Clock. Customer PLC time sync from DNSP RTU available.
Unsolicited/ Report by Exception	-	Yes (Function code 20, 21)

E.7 DNP3 Object Types

DNSP accepts DNP3 data types in the following formats as per Table 20. All data points shall be configured to report both Static and Event data.

Table 20: DNP3 Object Configuration

Type (example)	Description	Object	Variation	Notes	Class	Minimum
Digital	1-bit Binary Input Static	1	1	Single bit packed	0	✓
Digital	1-bit Binary Input Event	2	2	Input w/time	1	✓
Analog	32-bit Analog Input w/flag	30	1		0	
Analog	16-bit Analog Input w/flag	30	2		0	✓
Analog	16-bit Analog Input change event w/time	32	4		2	✓
Control Operation	Control Relay Output Block Preferred Configuration:	12	1		-	✓

Type (example)	Description	Object	Variation	Notes	Class	Minimum
	SELECT/OPERATE Trip/Close pair Pulse On, 500ms					
Setpoint Operation	16-bit Analog Output Block Preferred Configuration: DIRECT OPERATE	41	2		-	✓
Class 0	Class Objects – Class 0 data	60	1			✓
Class 1	Class Objects – Class 1 data	60	2			✓
Class 2	Class Objects – Class 2 data	60	3			✓
Class 3	Class Objects – Class 3 data	60	4			✓

Circuit Breakers shall be configured as two single bit digital input points as per the following table:

Table 21: 2-Bit Digital Status Configuration

Bits	State
00	Indeterminate
10	Open
01	Closed
11	Invalid

E.8 Analog Resolution

The following table indicates default resolution and delta bandwidth for analogue indications.

Table 22: Resolutions and Delta Bandwidth

Data Type	Units	Resolution	Constant Poll Δ Bandwidth
Apparent Power	MVA	0.01	0.1
Real Power	MW	0.01	0.1
Reactive Power	MVar	0.01	0.1
Current	A	0.1	1
Voltage	kV	0.01	0.1

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