Customer Guidelines for Low Voltage Connected Embedded Generation

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Glossary of Terms

Regulatory Terms

Term	Description
AEMO	Australian Energy Market Operator
DNSP	The owner and operator of the electricity distribution network (grid) to which the customer is connected. The retailer's energy must be delivered to the customer via the DNSP's poles and wires (network); the DNSP charges for this service. Sometimes referred to as a Distribution Network Service Provider (DSNP).
Embedded Generator	An entity which owns and operates generating units, which are connected within the distribution network and do not have direct access to the transmission network.
ESC	Essential Services Commission.
Market Generator	A Generator which sells all of its sent-out electricity on the national spot market and accepts payments from AEMO.
NER	National Electricity Rules
Network Service Provider	NSP is the owner and operator of a transmission network or a distribution network.
Non-Market Generator	A Generator which sells all electricity under contract to a retailer, or to a customer at the same connection point.
Point of Connection	The point on a distribution feeder at which an embedded generator is connected to the DNSP's network.
Retailer	The seller of electrical energy (as a market commodity) to customers otherwise than through the wholesale electricity market. Sells energy to any customer independent of location.
VEDC	Victorian Electricity Distribution Code.
NMI	National Meter Identifier
SIR	Victorian Service Installation Rules
CTA	Connection Technical Advisor
Revenue Metering	The monitoring and collection of data specifically for the purpose of metering revenue
Metering	The monitoring and collection of data
Generator Monitor	Network metering device for generator monitoring and control purposes.

Table 1 - Glossary of Terms

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Technical Terms

Term	Description
Active Power	The component of an AC electric current which is converted to mechanical power or to heat.
Demand	The power consumed by a customer at any point in time; normally measured by integrating kilowatt hours of energy consumed over a period 15 or 30 minutes, and expressed as an average in kilowatts. May sometimes be defined, measured and expressed in kilovolt-amperes.
Distribution Feeder	An electric line and associated equipment operating at a voltage of 6.6kV, 11kV or 22kV, which a DNSP uses to distribute electricity.
Distribution Network	A network which is not a transmission network.
Distribution System	A distribution network, together with the connection assets associated with the distribution network, which is connected to another transmission or distribution system. Network assets, on their own, do not constitute a distribution system.
Fault Level	The maximum electrical current, usually expressed in thousands of amperes (kA), which can flow at a point in the supply network if short circuit between phases or between phase(s) and earth and neutral.
Power Factor	A measure of the relative proportions of active power and reactive power in an AC load current; if p.f. = 1, all current is used in producing heat or mechanical power; if p.f. = 0, then all is used in maintaining magnetic or electric fields.
Quality of Supply	(At a point of supply to a customer): The degree to which the voltage of the electricity supply departs from a pure 3-phase sinusoidal waveform of constant magnitude and frequency.
Reliability of Supply	(To a customer) The extent to which power supply is available without interruption or curtailment over a long period of time. Usually quantified as availability (no. hours available/total no. hours).
Low Voltage	Refers to voltages less than 1kV AC. For Victoria typically 230V or 400V. Refer AS3000.
Zone Substation	The origin of distribution feeders at 6.6, 11 or 22 kV; contains transformers which reduce voltage from sub-transmission level (usually 66kV) to distribution level (6.6, 11 or 22 kV).

Table 2 - Technical Terms

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1. Introduction and Purpose

These guidelines are intended to cover the installation and connection of generating sources at Low Voltage and typically less than two megawatts (2 MW) to the CitiPower / Powercor networks.

A copy of these guidelines and other general information is available on the CitiPower/Powercor web site located under Our Services and Connecting larger embedded generator systems, refer to the attached link.

connecting-larger-embedded-generator-systems

The link also directs you to information on the following:

- connection process
- application forms
- Augmentation Agreement
- Generator Deed Agreement
- Customer Guidelines (for LV, HV and Sub transmission connections)

SOLAR CONNECTIONS

Applications for the following solar connection categories are available at the link below.

- Solar Inverter Connections up to 10kW single phase or 30kW three phase
- Solar Inverter Connections up to 150kW three phase.

solarwind-small-inverter-connections

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2. The Power Network

The CitiPower/Powercor LV Network limits transformer capacity to 2MVA per building service, hence the largest generation capacity will also be limited to a possible maximum* of 2MVA on the same building service.

This limit is indicative only, being dependent on the location, the nature of other loads on the relevant network section, and other local factors. It is sometimes necessary for CitiPower/Powercor to upgrade local networks to and/or modify the operational regime of the network to accommodate a generating plant whilst maintaining the required quality of supply to other customers.

Refer to The CitiPower/Powercor website for further information about the distribution network.

www.citipower.com.au or www.powercor.com.au

The connection process will identify the extent of network extension and augmentation that is required to facilitate a generator connection.

*system study or agreement may apply.

3. Connection Process

This connection process is for embedded generation connecting to the low voltage distribution network. Customers seeking to install an embedded generator must complete an ‘Embedded Generation Enquiry Application’ form located on the web site.

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Flowchart describing the connection process followed by CitiPower/Powercor

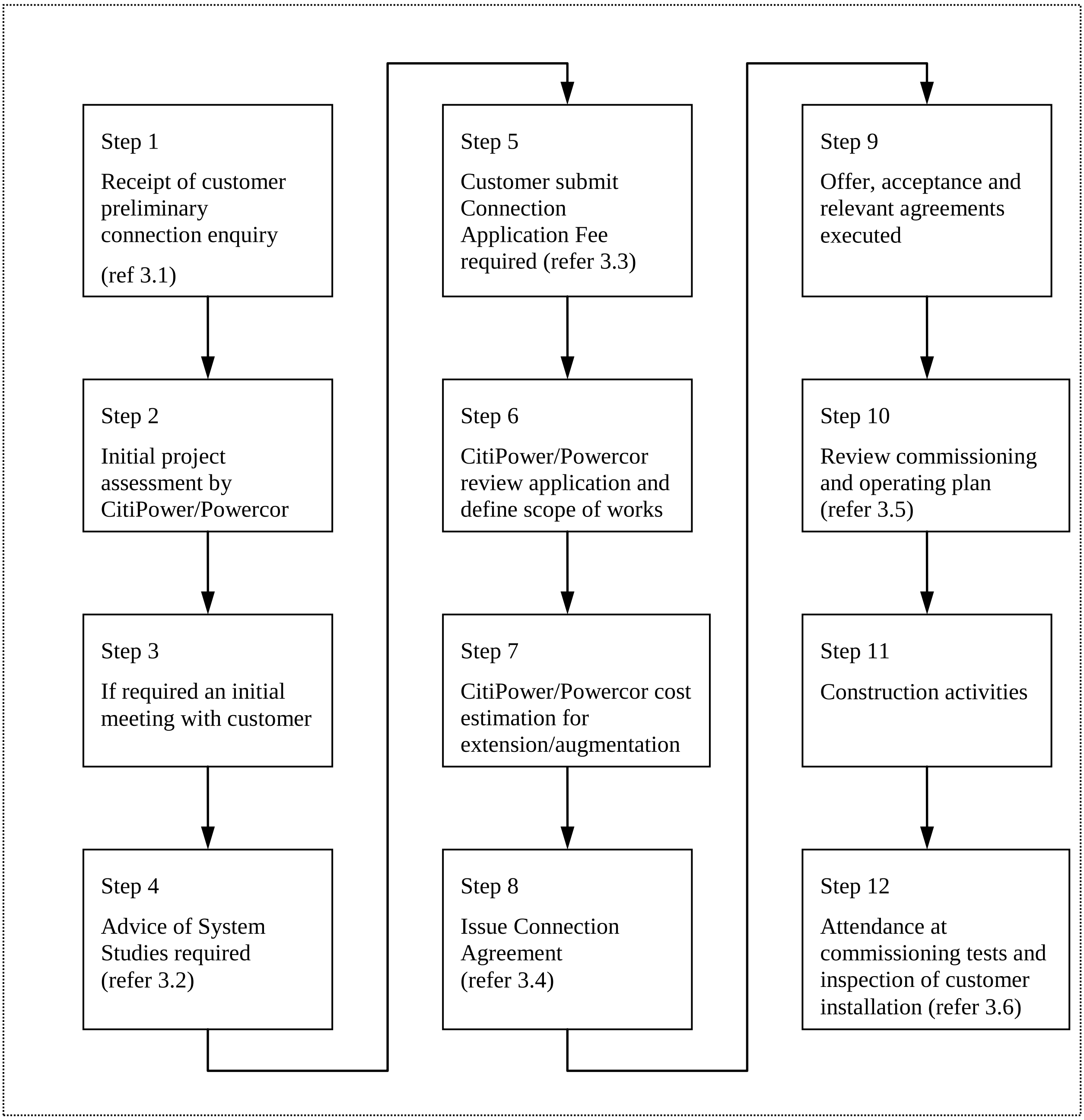

Figure 1 - Flowchart Showing LV Embedded Generation Process

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3.1. Embedded generation enquiries

For a Preliminary enquiry please complete sections 1 to 5 on the "Embedded Generation Enquiry application" form on the website. Section 6 of the application is not required for preliminary enquiry purposes.

3.2. Advice on system studies

CitiPower/Powercor will provide an initial assessment of the co-generator based on the preliminary details provided and will advise the necessary fees and study requirements.

The studies may include:

- Load flow outputs showing voltage profiles at the connection site and line loadings.
- Voltage fluctuation studies showing the impact at CitiPower/Powercor's adjacent HV & LV buses for the loss of full generation only and the loss of full generation with the connected load.
- Fault level contribution of the generator at full generation showing fault level increases at other relevant adjacent connection points.

3.3. Connection Application

An application to connect must include all the remaining technical details to determine the network requirements, including the following:

- A completed "Embedded Generation Enquiry" application form, section 1 to 6 inclusive.
- All technical information (including system studies & models) requested by the network planner.
- Applicable machine data (AVR's etc.)
- Single line diagram showing primary equipment and secondary & protection schemes
- Payment of the required application fee

Modeling completed by the customer will be reviewed by CitiPower/Powercor to ensure the studies demonstrate the proposed connection is feasible.

Connection of embedded generators may involve system augmentation costs.

Connection charges are determined in accordance with the principles of Electricity Industry Guideline No.15. This Guideline is available on the Essential Services Commissions web site.

The customer's installation must comply with the Victorian Electricity Distribution Code (VEDC) and Victorian Service Installation and Rules (SIRs). Refer to the links shown for latest versions.

VEDC: http://www.esc.vic.gov.au/Energy/Distribution/Electricity-Distribution-code

SIRs: http://www.victoriansir.org.au/

Note: Where these "Guidelines" conflict with the VSIRs. These "Guidelines" shall prevail.

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3.4. Offer to Connect

In order to provide an offer to connect a generator, CitiPower/Powercor will provide where required a "Connection Agreement". This agreement will include, an "Augmentation Agreement" and "Generator Deed".

The Augmentation Agreement covers the timeframes, costs and commercial arrangements for the Connection Works.

The Generator Deed covers the ongoing technical and commercial conditions to permit the embedded generator to be connected to the network. The connection of an embedded generator may require alterations to an existing supply agreement.

3.5. Commissioning & Operating plan.

The customer is to provide a schedule for commissioning tests and an Operating plan for ongoing operation and maintenance

The Operating Plan considers items such as normal operating mode and operation under abnormal or fault conditions.

The commissioning schedule covers pre commissioning and final commissioning tests including secondary and protection schedules and settings applied.

Pre commissioning tests may require the temporary ability to parallel with the network prior to final commissioning.

3.6. On Site Testing.

The customer shall arrange on site testing to include the CitiPower/Powercor Customer Technical Advisor (CTA) as a witness, to demonstrate the generator conforms to the test protocols and requirements agreed.

The Generator must pass the required tests before the Generator Deed is deemed to be executed.

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4. Standards and Guidelines

The following list is not necessarily updated and not exhaustive, it is intended as a guide to assist prospective Embedded Generator installers. It is incumbent on the proponent and proponents' consultant to ensure that the project complies with appropriate standards, guidelines and rules.

4.1. Australian Standards

Australian Standards are employed by the DNSP's to provide a standard approach for technical requirements. Below is a table that provides a list of relevant Australian Standards.

Australian Standards	Standard Title
AS 1319	Safety signs for occupational environment
AS 1359	General Requirements for Rotating Electrical Machines
AS 1931	High Voltage Test Techniques
AS 2006	Diesel Generators/internal combustion engines
AS 2067	Substations and high voltage installations exceeding 1 kV a.c.
AS 2184	Low voltage switchgear
AS 2344	Limits of electromagnetic interference from overhead a.c. power lines and high voltage equipment installations in the frequency range 0.15 to 1000 MHz
AS 2373	Electric Cables
AS 2374	Power Transformers
AS 2915	Solar Photovoltaic Modules – Performance Requirements
AS/NZS 3000	Electrical Installations (Wiring Rules), 3010 – Electrical Installations – Generating Sets, 3017 – Testing Guidelines
AS/NZS 3008	Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV
AS 3010	Electrical Installations
AS/NZS 3017	Electrical installations – Testing Guidelines
AS/NZS3100	Approval and test specification – General requirements for electrical equipment
AS/NZS 3439.1:2002	Low Voltage Switchgear and control gear assemblies
AS 4509	Stand-alone power systems, Parts 1,2,3
AS 4777	Grid Connection of Energy Systems via Inverters, Parts1, 2, 3
AS/NZS 5033	Installation of photovoltaic (PV) arrays
AS 60038	Standard Voltages
AS/NZS 60265.1	High-voltage switches - Switches for rated voltages above 1 kV and less than 52 kV
AN/NZS 61000 Series	Electromagnetic Compatibility
AS 62271 Series	High-voltage switchgear and control gear
AS/NZS 7000	Overhead line design standard

Table 3 – Australian Standards

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4.2. Other International Standards and Guidelines

To assist in providing a standard approach for technical requirements below is a table of International standards and guidelines which may be referred to.

The following list is not necessarily updated or exhaustive. It is intended as a guide to prospective Embedded Generators. It is incumbent on the proponent and proponents' consultant to ensure that the project complies with appropriate standards, guidelines and rules.

Associated Documents	Document Title
IEEE PSRC	Intertie protection of consumer-owned sources of generation, 3MVA or less
IEEE 1547	IEEE Standard for interconnecting Distributed Resources with Electric Power Systems
IEEE 519	Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
G59/2*	Recommendations for the connection of embedded generating plant to the DNSP's distribution systems and the provision of standby generators
G75*	Recommendations for the connection of embedded generating plant to Public distribution systems above 20kV or with outputs over 5MW
G83/18*	Recommendations for the Connection of Small-scale Embedded Generators (Up to 16A per Phase) in Parallel with Public Low-voltage Distribution Networks.
ETR 113*	Engineering Technical Report No ETR 113

* Energy Networks Association UK

Table 4 – Other relevant Standards and Guidelines for reference

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5. Technical Requirements

5.1. Summary of Control and Monitoring Requirements

This summary applies irrespective of the generator export capabilities to the CitiPower/Powercor network.

For sites where more than one generation installation is proposed, the *aggregated* capacity of the site, not the individual capacity of each installation, is to be used to determine the control and monitoring requirements as detailed in Table 5.

Embedded Generation Size	30kW - 200kW	200-500kW	500kW - 2MW
Disconnect Co generation signal from CitiPower/Powercor[1]	Not Required	Not Required	Required
Co-generation Disconnected Status[2]	Not Required	Not Required	Required
Main Co generator CB and/or Co generator CB status.[3]	Not Required	Not Required	Required
Analogue Monitoring[4]	Not Required	Required	Required
Refer Appendix A	Fig. 3 & 4	Fig. 5	Fig. 6

Table 5 – Control and Monitoring Requirements

Notes:

The above requirements are provided by way of the Generator Monitor.

1. Disconnect Co-generation signal from CitiPower/Powercor Network.
   - The "Disconnect Co-generator" signal indicates that the generator control scheme must act to electrically isolate the generator(s) from the CitiPower/Powercor network. The generator may still operate in 'Island Mode' however, it cannot be electrically connected to the CitiPower/Powercor network whilst the Disconnect condition is active. On receipt of this 'Disconnect' signal the isolation of the generator(s) must occur within 5 minutes.
2. Cogeneration Disconnected status.
   - This condition signifies that all embedded generators are electrically isolated from the Citipower/Powercor network. This feedback will be either via a physical hardwired signal from the LV Generator CB or via monitoring of the generator analogue quantities.
3. The Main Co-generator CB refers to the customer CB with the Loss of Mains and Interconnection protection.
4. Remote monitoring of 3 phase Amps, Volts, MW and MVAr at the generator or main generator CB (with or without export).

5.2. Asset Interface Labelling

Where the generator is connected and synchronised to the network the asset interface must be clearly labeled and defined for ownership and responsibility at the point of supply. Labelling shall be consistent with the electrical drawing of the system through the life of operation of the plant.

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5.3. Quality of Supply

The Victorian Electricity Distribution Code (VEDC) requires electricity DNSPs to maintain the quality of electricity supply to its customers in respect of:

- Steady state voltage
- Voltage fluctuations
- Harmonic voltages
- Voltage unbalance

In turn, customers are required by the same code to control:

- The power factor of their generation.
- The harmonic currents generated by their generators.
- The load balance between phases.
- The magnitude and rate of occurrence of generation fluctuations (which cause corresponding voltage fluctuations to be imposed on other customers).

The regulatory limits applicable to each of the above quality indicators may be found in the Victorian Electricity Distribution Code, which can be viewed on the website of the Essential Services Commission at:

www.esc.vic.gov.au

The customer must comply with these codes and CitiPower/Powercor will nominate any additional requirements.

5.4. Operation of Generators and the effect on network and customers

The stability performance of the generator shall be such as not to impact adversely on existing CitiPower/Powercor customers. CitiPower/Powercor may require stability studies to confirm this.

If required the individual machine model will need to be proven to match the machine specification and designated response.

5.5. Earthing of embedded Generators

Generators connected to the network via a delta/star transformer with the delta on the network side may have their neutral directly connected to earth. Effective isolation of this neutral will be required to inhibit the flow of harmonics through the neutral and the generator's method to limit harmonics must be discussed and agreed to by the DNSP.

5.6. Fault Level contribution

The installation of an embedded generator may raise the fault level of the network to which it is connected. System fault level studies may be required to determine the increase in fault level, and to determine the works required to ensure connection of the embedded generator will not result in fault levels exceeding the levels specified in Table 1 below. The design criteria for CitiPower and Powercor are based on these levels.

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The customer will be required to fund the necessary fault level studies.

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

Table 6 - VEDC Fault Level limits

CitiPower/Powercor shall nominate the amount of short circuit fault current the customer's generator is permitted to contribute. For synchronous generators, the short circuit fault current contribution to the zone substation distribution supply level (6.6, 11 or 22kV) will typically be limited to 2x the rated generator capacity. The calculation of short circuit currents will be in accordance with the latest version of Australian Standard AS 3851. Proponents should consider series reactors or the use of inverters as a means to limit fault level contribution. Other alternatives would need to be submitted to CitiPower/Powercor in order to ensure they were acceptable.

Australian Standard AS/NZS 3439.1:2002 Low Voltage Switchgear and Control Gear Assemblies deal with the fault current withstand required for embedded generators. Attention is drawn to the requirement for installations for commercial and industrial loads to achieve a rating of 50kA for 1 second.

Note: For fault level purposes, generators requiring momentary connection only will still be required to meet the same fault level requirements as permanently connected generators.

5.7. Short Circuit Withstand

In accordance with the wiring rules, the inspecting authority may require that the wiring of an installation be of a suitable size and construction and that the control gear and protective gear be suitably rated so that the installation is capable of performing satisfactorily under fault conditions. The short circuit current which may occur in a customer’s installation supplied from an indoor substation on the premises is relatively high and makes it necessary to design switchboards and cabling or buswork and carefully select protection and control equipment of adequate fault rating.

For LV customers, the installation design fault level shall be a minimum of 50kA for 1 second.

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5.8. Connection Configuration

The following is an example of a minimum connection configuration for generators >200kW.

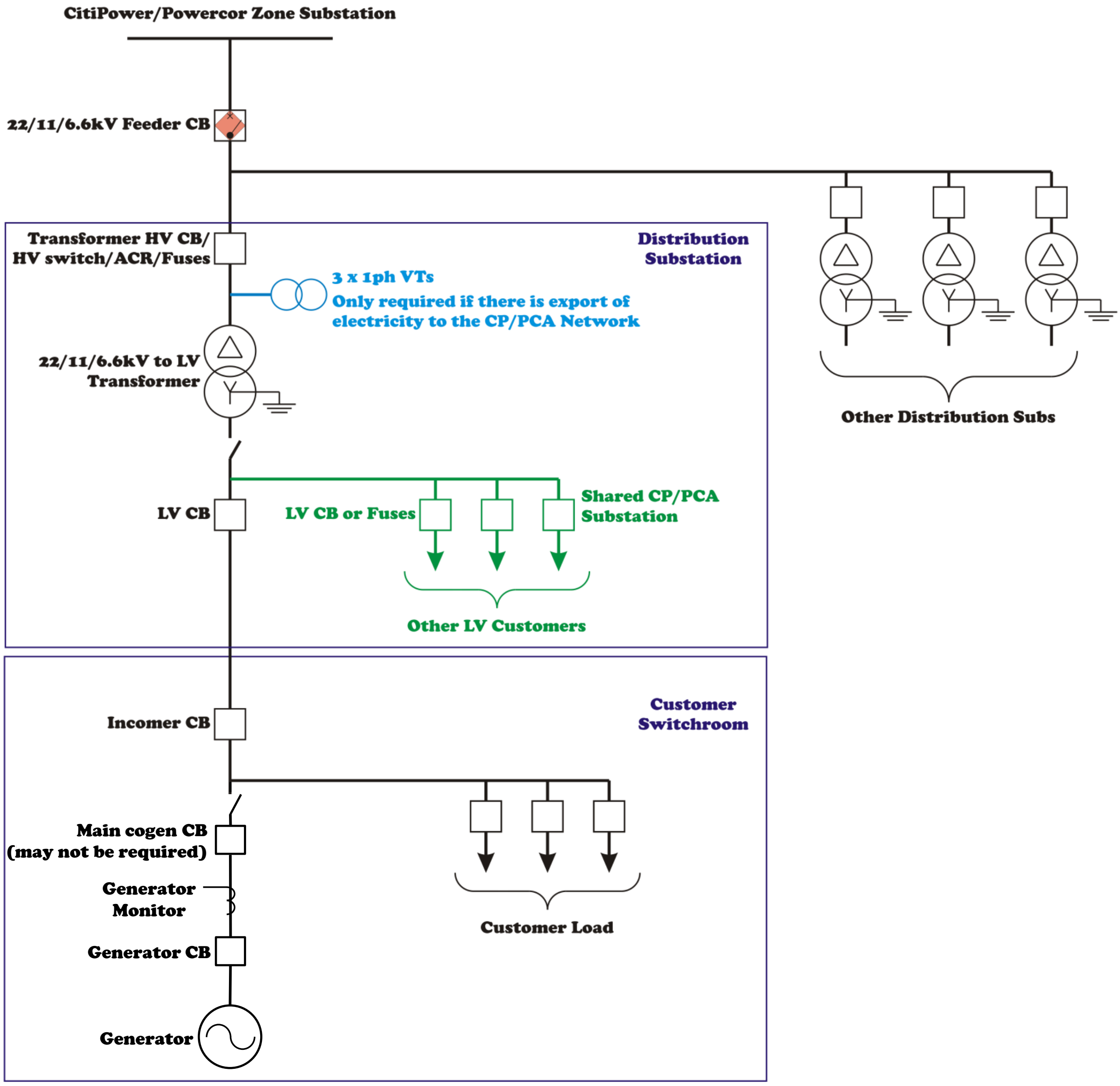

Figure 2 - LV Customer Minimum Connection Configuration

5.9. Generator Monitor

A Generator monitor is to be installed on the system side of each generator CB or Main Co-generator CB and connected to appropriately rated current transformers. This monitor will provide the Citipower/Powercor customer interface and enable the monitoring and control information requirements described in Section 5.1 to be met.

Refer section 10 for details.

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5.10. Auto Reclose

The CitiPower/Powercor system standard is for single shot auto reclose on all overhead HV distribution feeders. Generator manual or automatic restart facilities following a fault and system separation must make allowance for auto reclose operations.

The customer must ensure that for an auto reclose operation on the Citipower/Powercor system that all generators are isolated from the Citipower/Powercor system.

5.11. Synchronisation

All embedded generation synchronism requirements **shall** be provided within the customer’s generation installation.

The customer’s synchronism check can be either automatic or manual, although the CitiPower/Powercor preference is for automatic synchronism check.

An out-of-synchronism reconnection can result in:

- Damage to the generator windings, shaft, couplings and prime mover.
- Damage to other synchronous plant in the region.
- Mal-operation of protective relays on other utility feeders.

It is therefore essential to prove during commissioning that, for all normal conditions of preloading, disconnection of the customer switch room from the CitiPower/Powercor network due to a fault results in automatic disconnection of the generator/s in a time which is less than the auto reclose delay time.

5.12. Reverse Phase Rotation

The phase rotation across the CitiPower network varies. It is important that the generator proponent understand and be aware of the network phase rotation relative to the proposed generator location prior to project design.

5.13. Seamless Transfer (or Make before break)

The connection applicant needs to be aware that if the requirement is to parallel with the network under a make before break arrangement, the embedded generator will need to comply with these guidelines.

5.14. Islanding

Under certain network conditions, a protection and control operation may result in the embedded generator being disconnected from CitiPower/Powercor's network. If this occurs, the generator is permitted to continue to function in "island" mode, provided the generator is only supplying the generator owner’s electrical installation.

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5.15. Customer Protection Requirements

The customer installation protection design shall be based on detecting all faults within the customer's distribution system and operating the customer's circuit breaker's to isolate the fault without impacting the CitiPower/Powercor system. It is the customer's responsibility to determine all further performance requirements for the generator protection, given that the functionality will depend on the type of machine and its method of electrical coupling.

The protection design should include primary protection and back-up protection. Back-up protection can be via duplicated unit protection schemes with local CB failure schemes or via non-unit protection schemes. The back-up protection must cover all sections of primary plant and must provide protection for both relay failure and CB failure.

The protection design shall be carried out to 'best industry practice' and shall include the following principles:

- Adequate CT ratios and performance specifications such that protection mal-operations will not occur under the most severe system fault conditions as a result of CT saturation
- Overlapping protection zones with CT's located such that there are no 'blind spots'

In addition to the detection and clearance of faults the generator shall disconnect from the CitiPower/Powercor network if:

- The generator output becomes unstable causing unacceptable voltage and/or frequency deviations at the connection point.
- The AC/DC supplies to protection and/or control system equipment fails
- Protection equipment and/or control system equipment fails
- A 'Disconnect Co-generation' signal is sent from CitiPower/Powercor to the customer

The customer shall submit to CitiPower/Powercor a single line protection diagram of all protection proposed for acceptance at the start of the project. Detailed design and the purchase of any equipment should not proceed until written acceptance is received from CitiPower/Powercor.

5.15.1. Interconnection Protection

The customer shall include interconnection protection at the main generator CB or incomer CB. The interconnection protection functions may be incorporated into a multi-function protection relay along with overcurrent, earth fault and other protection functions required at the connection point.

The interconnection protection shall include over/under frequency and over/under voltage functions and at least one other type of anti-islanding protection.

Other types of anti-islanding protection can include, but are not limited to:

- Rate of Change of Frequency (ROCOF)
- Vector Shift

5.15.2. Non-Export or Export Limited Connection

Customer's connecting with no intention of exporting onto CitiPower/Powercor's Distribution Network or subject to an export limit that is less than their installed generation capacity shall install reverse power protection at the point of connection.

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5.15.3. Neutral Displacement

Neutral Displacement protection is required wherever an overhead section of the CitiPower/Powercor High Voltage network can be back-fed from an unearthed transformer winding or for other unusual system conditions.

To facilitate Neutral Displacement protection a suitable 22/11/6.6kV voltage transformer (VT) is required and shall be supplied by the Network on behalf of the customer. The supplied VT shall be either a single 5 limb three phase VT or three single phase VTs. The VT will be installed on the HV side of the distribution transformer and an appropriate interface provided to allow connection of the customer's relay performing the Neutral Displacement function.

The customer will be required to supply and install the protection relay performing the Neutral Displacement function along with associated equipment/wiring within the embedded generation facility and any cabling to the interface point. The Neutral Displacement protection function may be performed by an independent relay or be incorporated in the interconnection protection.

Neutral Displacement Protection is generally not required for:

- Solar generation or any other generation source that is connected to the network via inverter technology.
- Installations exporting less than 500kW
- Installations where export is limited by reverse power protection.

Due to the nature of the overhead electrical system, for some connections there may be a need for Neutral Displacement protection where export is less than 500kW. This requirement would be identified during the assessment phase of the connection application.

5.15.4. Protection Coordination

The settings of the customer's non-unit protection schemes must be coordinated with the CitiPower/Powercor network protection schemes. CitiPower/Powercor therefore requires full details of the customer's protection proposals during the design stage of the project. Where coordination with existing CitiPower/Powercor settings is not possible, the customer may propose revised protection settings. In some circumstances it may be necessary for CitiPower/Powercor to revise or upgrade their equipment.

It should be noted that the CitiPower/Powercor settings can only be revised within the boundaries of good protection design to ensure HV feeder faults are cleared within an appropriate time. The agreed protection design or settings must not be changed without prior approval from CitiPower/Powercor.

Details must include the following:

- Protective relay types and configurations.
- Protective relay operating characteristics.
- Proposed relay settings.

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6. Customer's Embedded Generator Operation and Maintenance

6.1. Operating Procedures

The customer will be required to have, maintain and use up to date Operating Procedures.

6.2. Trained Operators

The customer shall ensure that operators are appropriately trained.

6.3. Maintenance

A customer who operates an embedded generator shall ensure that the electrical installation, generator and associated protection and control is maintained in good order to ensure that any malfunction will not create a hazard or cause interference to CitiPower/Powercor's distribution network.

As a guide digital protection and control systems should be tested every five years and analogue systems every two years.

7. Testing and Commissioning

A Schedule of pre-commissioning tests will be developed by the customer for each embedded generator.

The tests required may vary depending on the size and type of generator and the location, and may include the following:

- Synchronising checks
- Proving correct operation of all protection that may include, but not limited to, loss of mains and neutral overload protection, over-voltage, frequency, reverse power and stator earth fault protection
- Proving functionality of communication systems
- Stability of all control systems including limiters

The customer will be required to ensure an electrically trained low voltage operator is present at all times during testing and commissioning to receive and execute DNSP operator instructions.

CitiPower/Powercor will not connect an embedded generator which in the opinion of CitiPower/Powercor is unsatisfactory for connection to the supply system.

8. Installation Approvals

Prior to the connection of embedded generating plant, CitiPower/Powercor's representative will inspect the electrical switchgear and the protection and control equipment. CitiPower/Powercor also wishes to be present when the plant safety features are being proven, and may carry out its own tests prior to commissioning of the plant on the CitiPower/Powercor network.

Subsequent to commissioning of the plant, CitiPower/Powercor must be consulted prior to any modification of the plant, equipment, protection or control schemes.

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9. Revenue Metering

Revenue or NEM metering is required for connection of all embedded generation or grid connected alternative sources of supply, and is separate to, and in addition to any other monitoring equipment required by the customer and/or the Network as defined in this document.

Revenue metering is required to comply with the requirements of the National Electricity Market and specifically with:

- The National Electricity Rules chapter 7.
  (And in particular Section 7.3.1 (i) Requirements for metering installations for non-market generating units.)
- The Victorian Electricity Customer Metering Code.
- The National Measurements Act and associated regulations.
- The Victorian Service and Installation Rules (and in particular chapters 6, 8 and 9).
- The Victorian Smart Metering functional specification (where applicable to loads below 160MWh per annum of consumption)

Revenue Metering can only be installed and maintained by AEMO accredited Meter Providers.

Revenue Metering shall consist of a bi-directional interval meter with 30 minute import and export real energy data streams as required under the NER chapter 7.

In accordance with the NER requirements under section 7.3.1(i) Requirements for metering installations for non-market generating units, CitiPower / Powercor, as the Local Network Service Provider, requires 4 quadrant real and reactive energy interval metering on all 3 phase LV CT connected metered sites, and all other direct connected metered sites in excess of 160MWh consumption per annum, as part of its approval for connection of an Embedded Generator to its Network.

Where the customer load metered demand is in excess of 120kW that metering shall be 15 minute interval data metering.

While this metering is normally provided by the Responsible Person and their selected Meter Provider, the customer or generator operator must ensure the metering installation design and engagement of appropriate RP/MP will comply with these specific requirements, and ensure Revenue metering is segregated from any remote control, monitoring and measuring equipment.

Where the electrical installation incorporates parallel generation facilities in addition to customer load, the metering installation shall be designed as net metering at the point of supply, unless specifically agreed or approved to be designed as gross metering by CitiPower / Powercor as the LNSP.

Where a multiple occupancy site has a landlord operated parallel generation or embedded generation facility, it shall be net metered with the landlord’s common area and building services loads, and separate to tenancy metering.

Where a landlord establishes an Embedded Network, any subtractive calculations for export and import at the parent meter will be the responsibility of the Embedded Network Operator and the RP/MP engaged at the Parent Metering.

Revenue Metering energy values associated with the settlements in the NEM, or Electricity Retailer transactions, in multiple occupancies and Embedded Networks, may vary significantly from the actual connection point energy and demand loadings applied to the CitiPower and Powercor Distribution Network, and hence Control, Monitoring and Measurement equipment, to be independent to, and segregated from, the Revenue Metering equipment.

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10. Generator Monitor (Network Device)

The Generator Monitor is a Network Device (as defined under NER chapter 7, clause 7.8.6) and is installed and wired to a similar design to Revenue or NEM metering but is NOT utilised in Market Settlements or Retail / Network billing, and instead is installed to meet Network requirements for engineering measurement and status data relating to the ongoing monitoring of the Generator.

Hence the Generator Monitor, as a Network Device, remains under the ongoing control of the Distributor.

The installation is to be undertaken in accordance with the requirements of Chapter 8 of the Victorian Service and Installation Rules, and 8.11 LV "Current Transformer Metering", in particular, and a typical wiring diagram is shown in Appendix C.

The Distributor will provide 3 x Low Voltage Current Transformers, and up to a 10 metre long Standard Metering Loom for installation by the customer's REC on site in accordance with the VSIR requirements in 8.11.5, 8.11.6 and 8.11.7. (Note: CT's shall be mounted with the label "This side to Incoming Supply" or P1 or with a red dot facing the Distributor incoming supply, NOT the generator.)

The Current Transformers provided by the distributor shall be Type S, Type T or Type W, as per VSIR 8.11.3.2 and Figure 8.11-E.

The Customer provides the CT Chamber, the 32A Fuse bases and cartridges, and 4mm SDI wiring from the busbar to the 32A fuse bases as per VSIR 8.11.7.1.

The CT Chamber will be provided in accordance with 8.11.5 of the VSIR's and be labelled "Generator Monitor Metering Transformers" complying with VSIR clause 5.4 (Labelling).

The Customer provides the Generator Monitor I/O wiring to the Meter board location.

The Generator Monitor I/O wiring will be in accordance with Appendix B, and will consist of one passive input and one output. The output is for control purposes only and may be used to drive a slave relay or digital input but may not be used for direct tripping of circuit breakers.

To allow for different installations with varied control voltages, the Generator Monitor output is provided as a voltage free contact. The customer is to provide an appropriate extra low DC control voltage for switching by the Generator Monitor output. This voltage is to be limited to a maximum of 50V DC with suitable fusing at the Generator end of the wiring.

The Customer will deliver to the Distributor the Meter Panel for fit-out by the Distributor as per VSIR 8.11.2.4. The Distributor shall prepare and install the meter panel with the Meter Test Block, fuses and Meter and any specific communications equipment such as aerials.

Where the Generator Monitor Metering is to be located within a basement or internal switch room, a remote antenna (outside of the building) may be required for communication. During negotiation of supply the customer will need to consult with the Distributor in the installation of conduit and antenna cabling.
This conduit, draw wire or antenna cabling installation and any wall penetrations shall be done by the customers REC, as per VSIR 8.12.2.1

The Distributor will install the meter panel and connect the standard loom wiring to the CTs and meter panel and commission the Generator Monitor into service.

The CT's, meter, communications and meter test block remain the property of the Distributor.

The Generator Monitor/Network Device, associated fusing and test block, along with the CT Chamber, will be sealed by the Distributor and is not to be accessed by others.

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This Generator Monitoring and Network Device equipment is to be independent to, and segregated from, the Revenue Metering equipment.

10.1. Generator Disconnection Control

Where the Generator disconnection control is installed, the Distributor's preference is for the downstream Generator Circuit Breaker/s to be controlled by the Generator Monitor. This ensures that only the generators are disconnected and all other customer supply is maintained. For this arrangement the Generator Monitor connection is to be as per Appendix C.

Where the Generator disconnection control is installed and is controlling a Circuit Breaker upstream of the Generator Monitor i.e. Main co-gen CB or Incomer CB, then the connection arrangement is to be as per Appendix D.

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11. Environmental

Environmental issues can impact the cost of a connection.

Each embedded generator technology will present unique environmental issues that the proponent will need to manage. In addition to these there will be environmental issues associated with the electrical connection itself.

These may include:

- Easements
- Clearances
- Visual amenity
- Electromagnetic compatibility
- Cultural Heritage
- Conservation of Native Vegetation
- Third Party Land User Consent
- Other

The DNSP will likely address many of these issues for the line to the proponent's boundary but there will be a number of environmental issues that will need to be managed and accountability established.

The proponent should also be aware that if there are significant environmental issues with the power connection that could have been addressed or avoided at the site selection stage, there could be significant cost and delays associated with the connection.

12. Safety

Embedded generators should ensure that safety legislation and standards are complied with including any additional conditions that may be applied by the DNSP. These should include consideration of the connection assets and site security.

13. Contact Details

Refer to the Citipower/Power or websites (www.Powercor.com.au or www.Citipower.com.au) for contact details.

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APPENDIX A – Typical Connection Arrangements

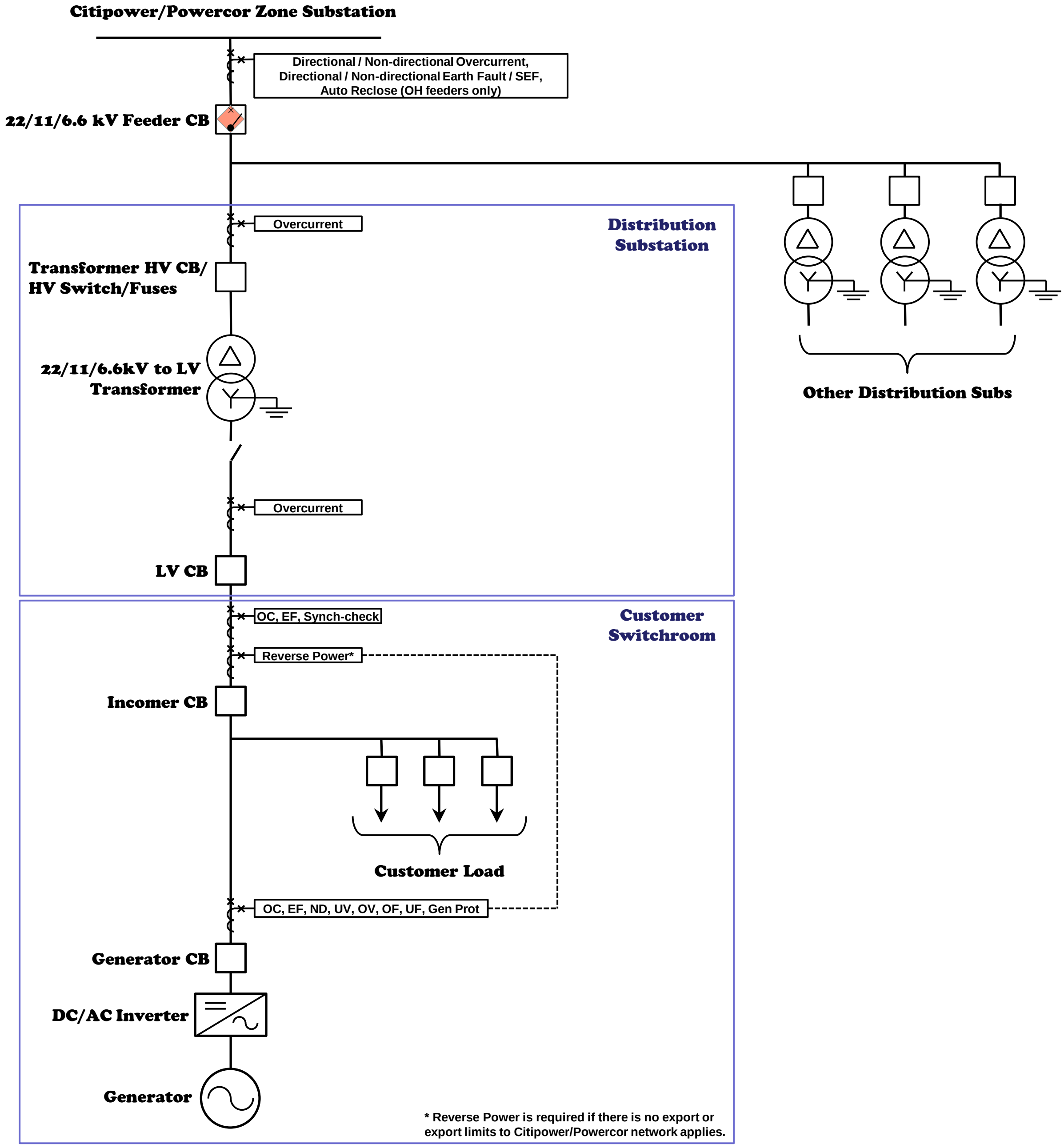

Figure 3- Protection scheme example 1: 30kW – 200kW inverter connected generation.

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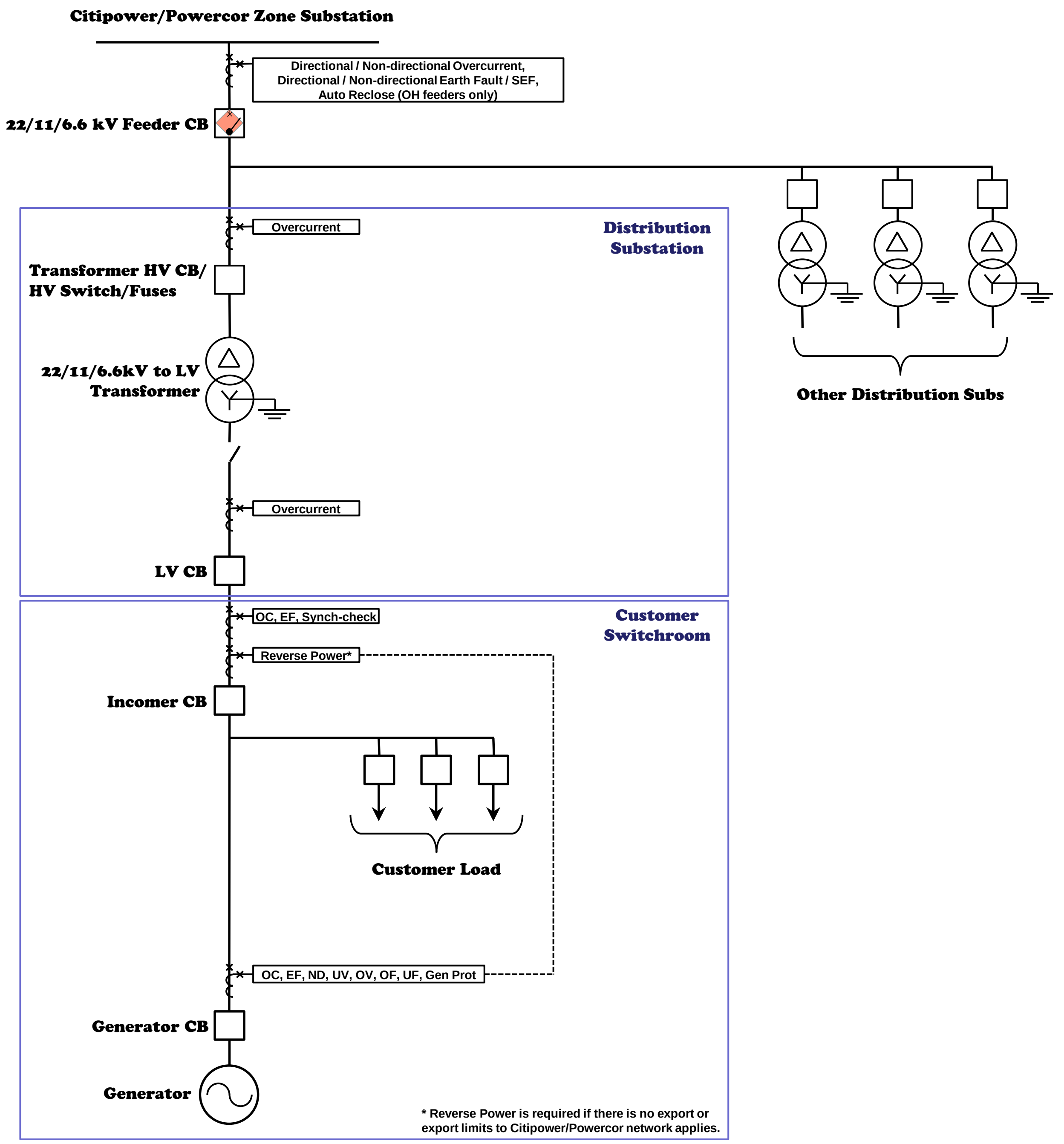

Figure 4 - Protection scheme example 2: 30kW – 200kW generation [Rotating machine].

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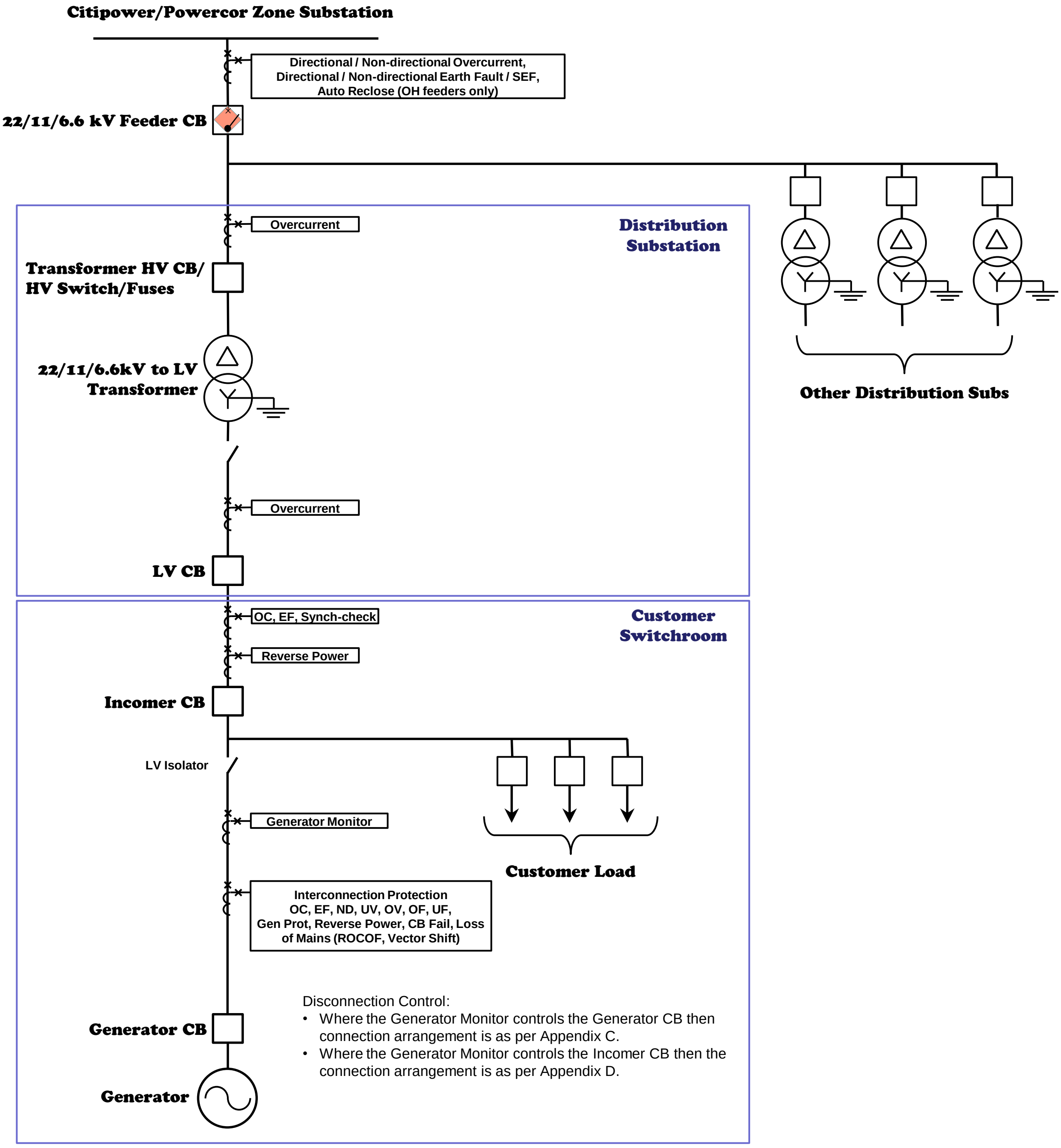

Figure 5 - Protection scheme example 3: 200 kW – 500 kW generation with export [e.g. synchronous generator].

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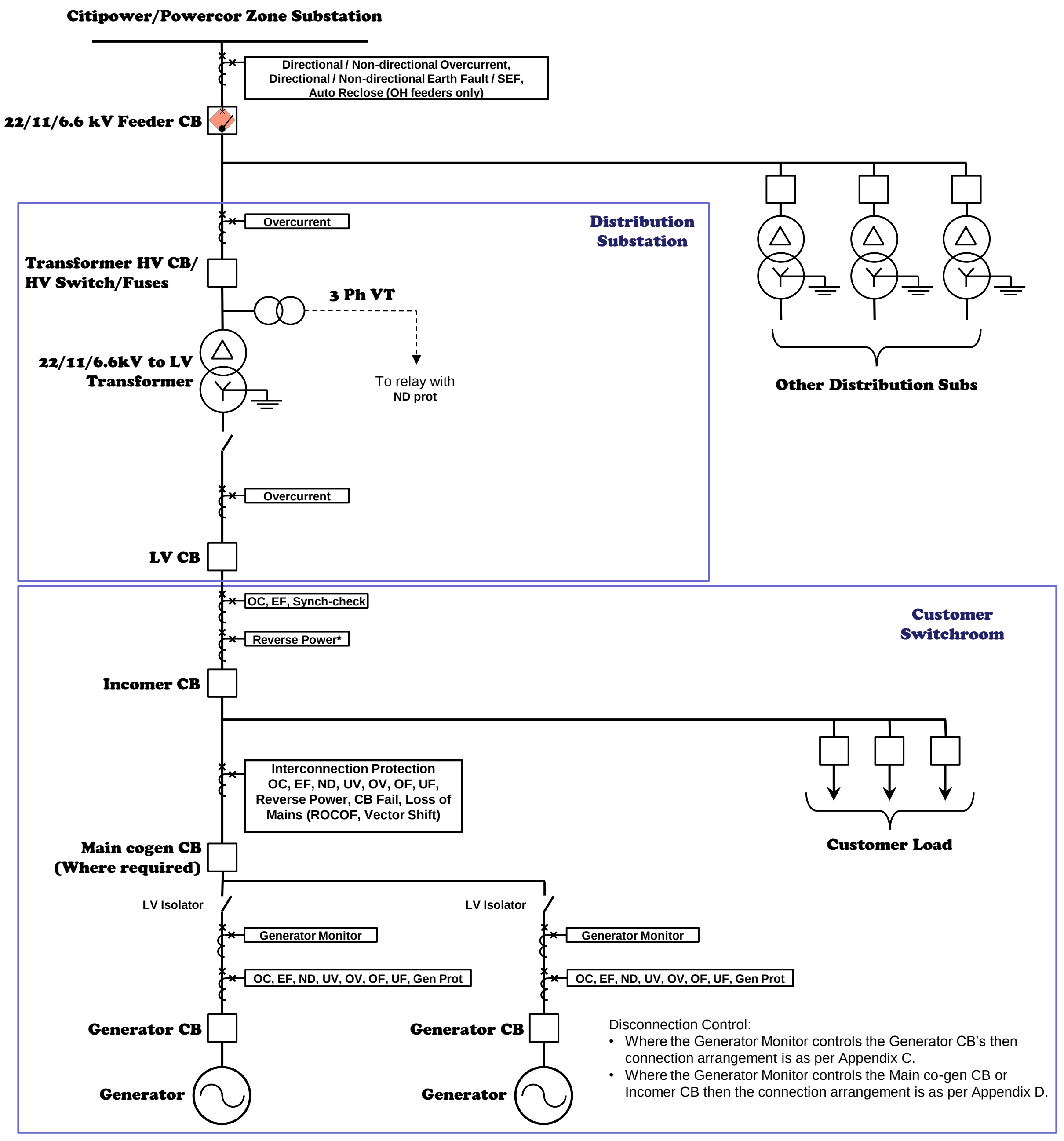

Figure 6 - Protection scheme example 4: 500 kW – 2 MW generation with export [e.g. synchronous generator].

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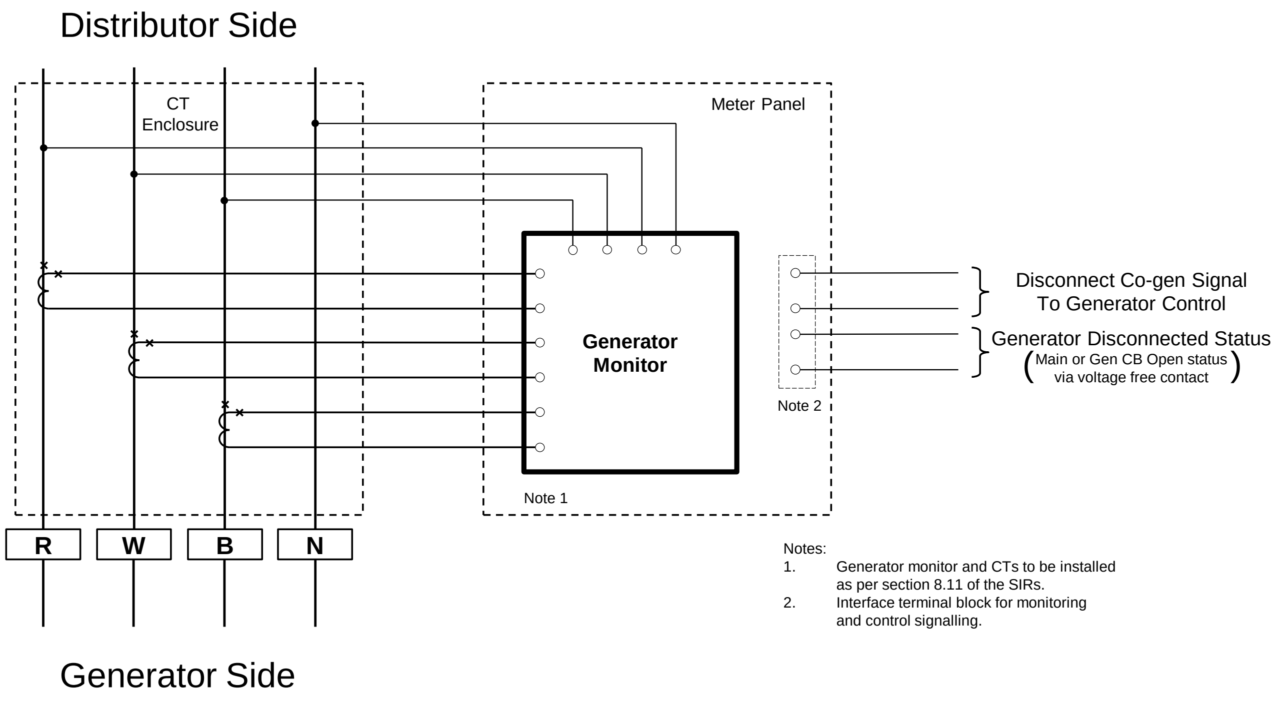
APPENDIX B – Generator Monitor Connection Example



- Labels to be attached to Meter Panel and CT chamber to read as per sample below.

> GENERATOR MONITOR
> This network metering device is for the purposes of monitoring the embedded generator.
> *For enquiries about the Generator Monitor –
> CitiPower **13 12 80** Powercor **13 24 12 121**

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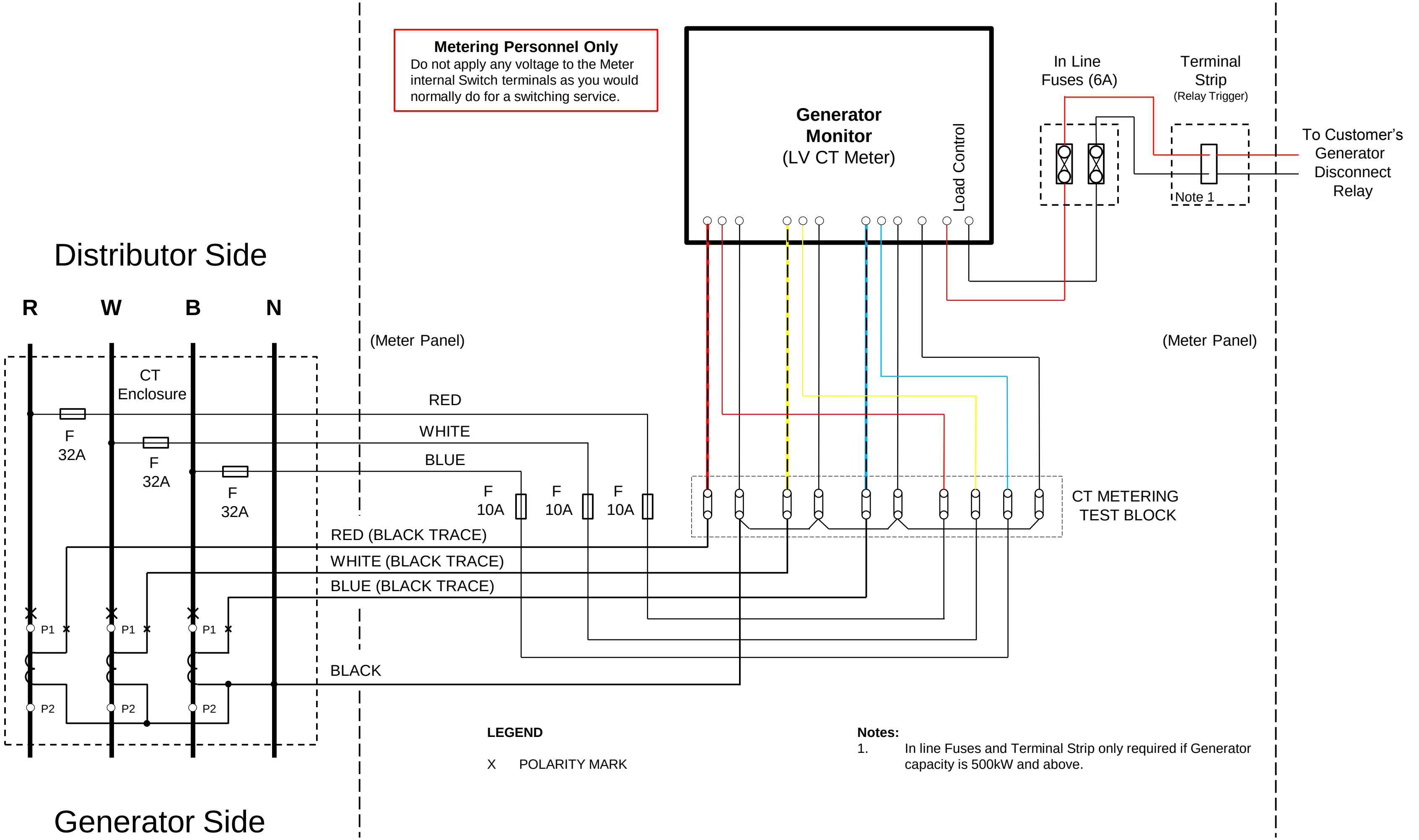
APPENDIX C – Typical Wiring Diagram for Generator Monitor (Generator CB Control)



LEGEND

X POLARITY MARK

Notes:

1. In line Fuses and Terminal Strip only required if Generator capacity is 500kW and above.

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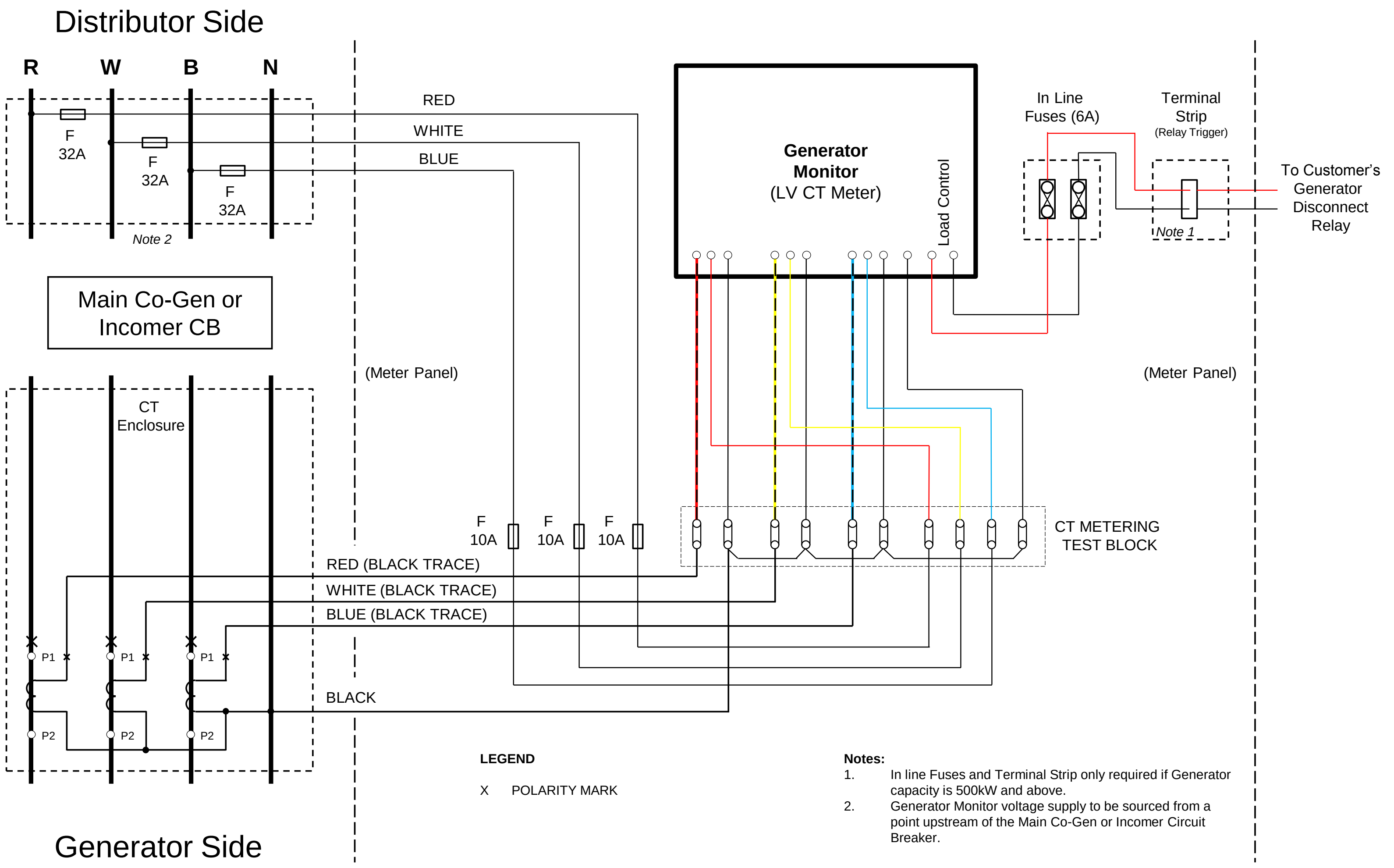
APPENDIX D – Typical Wiring Diagram for Generator Monitor (Main Co-Gen CB or Incomer CB Control)



Notes:

1. In line Fuses and Terminal Strip only required if Generator capacity is 500kW and above.
2. Generator Monitor voltage supply to be sourced from a point upstream of the Main Co-Gen or Incomer Circuit Breaker.

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