

Customer Self Supply Guidelines - CSSG (Peel)

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Version 2.0

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Document Acceptance and Release Notice

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Version History

Version No.	Published Date	Description of Change
1.0	28 July 2020	New document
2.0	27 August 2020	Updated to new entity name; Tas Gas format.

Amendments in this Version

Section No.	Section Title	Amendment Summary
		New document

References

Cited in this Document

Title	Document Number
AS/NZ 4777.1:2016 Grid connection of energy systems via inverters Installation requirements.	
AS/NZS 2067:2016 Substations and high voltage installations exceeding 1 kV a.c.	
AS/NZS 3000:2018 Electrical Installations Wiring Rules.	
AS/NZS 3010:2017 Electrical installations - Generating sets	
AS/NZS 4777.2:2015 Grid connection of energy systems via inverters Inverter requirements.	
AS/NZS 5033:2014 Installation and safety requirements for photovoltaic (PV) arrays.	
Clean Energy Council approved inverters list.	
Customer Connection and Contribution Guidelines (CCCG) (Peel).	BMSDOC-18-2203
Electricity Corporations Act 2004 (WA).	
Network Performance and Planning Criteria Manual - NNPC (Peel) .	MSDOC-18-2210
WA Distribution Customer Connection Manual (WADCM).	
WA electrical Requirements (WAER).	
WP Technical Rules.	

Additional Reading

Title	Document Number

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1. INTRODUCTION

1.1 Background

The Peel Business Park (PBP) is a large industrial and agri-business precinct located near Nambeelup, and approximately 7km north-west of Mandurah, WA. PBP has an overall area of approximately 1,000 hectares and is being developed in several stages. Reticulation of power within Peel Business Park is through a network referred to as the Peel Microgrid, owned and operated by Peel Renewable Energy Pty Ltd (Peel) a subsidiary of Tas Gas Holdings Pty Ltd.

Approximate geographic boundaries for PBP and the first precinct are outlined below.



Figure 1. Peel Business Park Overview (courtesy of CBRE/Landcorp)

1.2 Definitions

Term	Description
Peel Tas Gas	Peel Renewable Energy is a subsidiary of Tas Gas Holdings Pty Ltd, Tas Gas Holdings Pty Ltd includes, but is not limited to, the following subsidiaries: <ul style="list-style-type: none"> • Tas Gas Holdings Pty Ltd (TGH) • Tas Gas Networks Pty Ltd (TGN) • Tas Gas Retail Pty Ltd (TGR) • Regional Energy Victoria Pty Ltd (REV) • Peel Renewable Energy Pty Ltd (PRE) • Peel Renewable Energy Genco Pty Ltd (PRE) • Gas Networks Victoria Pty Ltd (GNV) • Gas Pipeline Victoria PTY Ltd (GPV)
Augmentation	means the capital upgrade of the Peel Microgrid or the WP Network required to meet the electrical growth requirements of Customers.
CC&CG	means the Customer Connection and Contribution Guidelines BMSDOC-18-2203
CSSG	means the Customer Self Supply Guidelines BMSDOC-18-2212 (this document)
Customer	means a person supplied or to be supplied with electricity by Peel Renewable Energy at the PBP.

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Term	Description
Customer's Agent	means a person acting on behalf of a Customer or any other person otherwise requiring connection and/or a supply of electricity and may include a builder, developer, tradesperson or similar person.
ENAC	<i>Electricity Network Access Code 2004 (WA).</i>
HV	Means High Voltage (typically 22kV for the PBP). (kVA)
LV	means Low Voltage (typically 415V for the PBP).
NP&PCM	means the PBP - Network Performance and Planning Criteria Manual.
PBP	means the Peel Business Park located near Nambeelup, WA.
Peel Microgrid	means the vertically integrated electricity networks and generation assets that are located at the PBP and operated by Peel Renewable Energy and any of its Related Bodies Corporate
RMU	means Ring Main Unit.
ROCOF	Rate of Change of Frequency protection (type of generator anti-islanding protection)
Self-Supply Guidelines	the terms and conditions of that name published on Peel Renewable Energy's website from time to time.
SIES	Small Inverter Energy Systems as defined in section 3.2 of these Guidelines
UG	means Underground (i.e. below ground cable-based infrastructure)
VVS	Voltage Vector Shift protection (type of generator anti-islanding protection)
WA	means the state of Western Australia
WADCM	means the Western Australia Distribution Connection Manual
WAER	means the Western Australia Electrical Requirements
WP	means the Electricity Networks Corporation, established under the <i>Electricity Corporations Act 2004 (WA)</i> and trading as Western Power

1.3 About the Peel Microgrid

The Peel Microgrid takes supply at 22kV from the WP Network under a conventional customer arrangement. The Peel Microgrid incorporates an internal 22kV cable network supplying several 22kV/415V distribution substations. Individual sites within the PBP are typically supplied via radial low voltage supplies from these distribution substations.

Electricity is supplied to Customers at the Peel Microgrid from, variously:

- the WP Network by Synergy, under an electricity supply agreement between Synergy and Peel Renewable Energy
- local renewable generation and storage infrastructure connected directly to the Peel Microgrid.

Because the Peel Microgrid is connected to the WP Network by means of a conventional Western Power customer connection, the Peel Microgrid is subject to a range of technical, safety, regulatory and related obligations that are imposed by law or under arrangements between Peel and Western Power and Synergy, respectively.

Enwave is required to comply with these overarching obligations in relation to the connection of Customers, the modification of Customer equipment and facilities and the Augmentation of the Peel Microgrid and, in some circumstances the Augmentation of the WP Network.

1.4 Purpose and Scope

This document describes processes and requirements for connections that incorporate alternative forms of self-supply (e.g. customer generation) to the Peel Microgrid. The document has been developed to help ensure self-supply connections to the Peel Microgrid are implemented, operated and maintained in a way consistent with good electricity industry practice and applicable regulatory requirements.

This document is focused on self-supply generation and does not cover requirements for connecting loads to the Microgrid. As all self-supply facilities with the Business Park must be associated with a new or existing

load connection, this document should also be read in conjunction with the Peel Business Park Customer Connection and Contributions Guidelines (CC&CG).

This document does not address Peel's roof-top solar lease offer, under which Customers and Enwave may agree for Peel to lease Customer unused roof space for the purposes of Peel installing generation and storage infrastructure, which is used to provide renewable energy to the Microgrid. To find out more, including the potential to earn an ongoing revenue stream from unused roof space, contact Peel to discuss.

1.5 Competency and Use

This document is intended for use by Peel (in its capacity as operator of the Peel Microgrid), Customers, Customer's Agents and Third Party Retailers, and associated industry parties and personnel.

Users of this document should have general familiarity with systems, equipment and practises commonly used for electrical installations, distribution systems and associated connections, particularly in Western Australia.

1.6 Employing a Licensed Person

The *Electricity (Licensing) Regulations 1991* (WA) requires that all electrical work carried out on electrical installations connected to or intended to be connected to the WP Network will be performed by persons holding the appropriate electrical worker's licenced (as issued by the Electrical Licensing Board).

1.7 Contact Information

Contact for any matters related to the contents of these Guidelines may be made through written correspondence to Peel.

Any enquiries relating to emergencies or a specific requirement should be directed to the Peel Business Operations Manager as below:

Rob Breden GM Business Development
Mobile: +61 0431828550
Email: Rob.Breden@PeelRenewableEnergy.com.au
Address: 65 Hay Street, Subiaco WA 6008

2. COMPLIANCE AND REGULATIONS

2.1 Regulation of Electricity Industry in WA

Key players in Western Australia's electricity sector in the South West, include:

- Energy Policy WA
- Synergy
- Western Power
- AEMO
- the WA Rule Change Panel
- Economic Regulation Authority of Western Australia
- Energy and Water Ombudsman Western Australia (**Energy Ombudsman**).

In summary, Energy Policy WA is responsible for the delivery of energy policy and transformation strategy to the Minister for Energy.

Synergy is the Western Australian Government owned gentailer responsible for supplying all "small customers" connected to the Western Power Network, as well as owning the majority of generation capacity in the South West.

Western Power owns and operates the Western Power Network, to which the Peel Microgrid is electrically connected.

AEMO is the market operator and system manager of the Wholesale Electricity Market, which is established in the South West while the Rule Change Panel is responsible for assessing rule change proposals to the rules that govern the Wholesale Electricity Market.

The Economic Regulation Authority:

- regulates third party access to the WP Network under the Electricity Networks Access Code (2004) WA (ENAC)
- administers the electricity licensing regime
- monitors and reports on the compliance of electricity wholesale market participants.

The Energy Ombudsman receives and resolves complaints relating to electricity providers across WA.

2.2 Regulation of the Peel Microgrid

Peel operates the Peel Microgrid pursuant to the Project Deed between it and DevelopmentWA.

Peel also holds a distribution licence and a retail licence under the Electricity Industry Act (2004) WA (Electricity Act), under each of which it is required to comply with a range of legislative and regulatory obligations in relation to the operation of the Distribution Network and the supply of electricity to Customers.

The Peel Microgrid is not subject to pricing regulation of the Economic Regulation Authority as is the case with Western Power.

2.3 Consideration of WA Distribution Connections Manual

This document has been prepared to maintain consistency with applicable requirements contained within Western Power's Technical Rules. This is to ensure the Peel Microgrid provides users with comparable levels of security, reliability and quality of supply to similar users supplied from the WP network and in compliance with WP requirements.

All requirements within the WP Technical Rules apply equally to customer installations with self-supply/generation facilities within the Peel Microgrid and in particular Section 3.

3. GENERAL INFORMATION AND REQUIREMENTS

3.1 General Approach

Suitable sources of alternative supply may be connected within customer-owned facilities for self-supply, non-export purposes only (unless otherwise agreed). The non-export requirement constrains sources of alternative supply to new or existing customer installations having sufficient load to absorb all generated energy.

Peel should be contacted as early as practical when considering new, or altering existing, connections to the Peel Microgrid, including any of the following:

- New PV solar or other inverter-based systems, including any battery storage,
- Backup/standby generation or alternative supplies of any form,
- Increasing the capacity of any existing generating, backup or alternative supply facilities,
- Significantly altering existing systems in a way that could affect voltage, power-factor or power quality (also refer *PBP Network Performance and Planning Criteria Manual - NNPC (Peel)* [BMSDOC-18-2210]),
- Altering the protection, metering or control/monitoring facilities of existing generating/self-supply facilities,
- Altering the location or connection arrangements for existing facilities, (including relocating switchboards or incoming cables),
- Permanently reducing output capacity of existing facilities,
- Permanently or temporarily decommissioning existing facilities,

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- Changing load requirements associated with existing generating/self-supply facilities (also refer to the PBP *Customer Connection and Contribution Guidelines (CCCG) (Peel)* [BMSDOC-18-2203]).

Peel will generally have specific set of requirements and expectations that will need to be accommodated in the layout, design and establishment of the connections and associated electrical installation. It is only through the connection process described in this document that these requirements can be confirmed and agreed before being implemented.

3.2 Types of Alternative Supply Systems

Clause 15.2 of the WA Distribution Connections Manual defines generation system categories as summarised in Table 1.

Table 1: WADCM Generator Category Summary

Category	Summary
Micro	LV inverter based (AS 4777) single or multi-phase systems up to 5kVA
Mini	LV inverter based (AS4777) three-phase systems 5kVA to 30kVA
Small	LV systems 30kVA to 150kVA; HV systems 30kVA to 1MW
Medium	Systems over 1MW and up to 5MW
Large	Systems over 5MW

While this categorisation may be useful for promoting consistency across the industry, it does not align with the way generation systems are described and treated within the WP Technical Rules. Accordingly, for the purpose of these Guidelines and to coincide with requirements of the WP Technical Rules, alternative supply systems have been distinguished by types as given in Table 2.

Table 2: Types of Alternative Supply Systems

Type	Description
Standby	Standby/backup systems that do not operate in parallel with the network (AS 3010)
Small Inverter Energy Systems (SIES)	Small LV inverter energy systems rated up to 10kVA per phase (AS 4777)
Other Small Systems (SS)	Systems with combined installation rating of less than 10MW (excluding SIES and Standby)
Large Systems	Systems with combined installation rating of 10MW or greater

Further technical information for each type of system is provided in Section 4 of these Guidelines.

3.3 Conditions of Connection

AS noted earlier, Peel does not (unless otherwise agreed) offer connection of exporting generating systems to the Microgrid, due to the vertically integrated character of the network. Connections are also subject to a wide range of conditions encompassing regulatory, technical and commercial aspects. These cover matters such as installation safety, design, costs/payment, timeframes and generation/electrical parameters that must be met in order to connect.

Applicable conditions can be found throughout these Guidelines and are also included in relevant legislation/regulations, standards and documents including but not limited to:

- applicable legislation, including the Electricity Act (1945) WA, Electricity Act,
- Electricity (Licensing) Regulations (1991) WA and WA Electricity Requirements (as issued by the Director of Energy Safety) which sets out minimum requirements for all Electrical Installations in WA

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- Applicable Australian Standards including but not limited to AS/NZS 3000, AS/NZS 2067, AZ/NZS 4777, AS/NZS 3010 and AS/NZS 5033
- Applicable requirements of Western Power including within their Technical Rules and Guidelines for Connection of Generators, as well as applicable sections of the WA Distributions Connections Manual
- Specific requirements for the Peel Microgrid including these Guidelines, *Network Performance and Planning Criteria Manual - NNPC (Peel)* [BMSDOC-18-2210]
- as well as related connection/supply contracts with Peel.

3.3.1 Export

Peel may consider the connection of exporting generating systems to the Microgrid in the circumstance where such generation may be beneficial (in Peel's opinion) to the overall efficiency of the Microgrid, including with respect to the impact of such generation on factors such as the:

- renewable energy content
- the cost (on an unbundled basis) relative to other available source
- the controllability including overall power quality and reliability of the Microgrid.

3.4 Availability of Connection

Where applicable conditions and technical requirements are satisfied, Peel will agree to the connection and operation of suitable self-supply facilities with a customer's electrical installation.

Customer's should not assume a connection will be available for a specific proposal until they have written confirmation and agreement from Peel. Accordingly, proponents should avoid making any commitments (e.g. purchase of equipment etc) until a formal connection offer has been received following the application process detailed in Section 3.7.

Availability of a connection will be subject to the range of conditions outlined in Section 3.2, as well as a more specific set of terms and conditions contained within the Peel Connection Offer. This may include the requirement to arrange and/or fund any augmentation or alterations to the Peel Microgrid to allow the connection to proceed.

3.5 Augmentation of the Network

As self-supply facilities will only be associated with new or existing load connections, any necessary network augmentation will be managed in accordance with the PBP *Customer Connection and Contributions Guidelines (CC&CG)* BMSDOC-18-2203.

3.6 Metering

The metering requirements described in the PBP *Customer Connection and Contributions Guidelines (CC&CG)* BMSDOC-18-2203 applies to all load connections within the Peel Microgrid including those with self-supply facilities. Applicable metering shall record both gross consumption and self-generated consumption within the site electrical installation.

3.7 Connection Process and Requirements

3.7.1 Process Overview

The process for implementing any new or modified connections to the Peel Microgrid is generally made up of the following key phases:

- **Application Phase:** involving initial enquiry/discussions, planning and finalising an application.
- **Review and Confirmation Phase:** including detailed assessments, preparation of a connection offer and Customer acceptance.
- **Implementation Phase:** including Customers installation and connection works, coordination, inspections, testing and commissioning.

Error! Reference source not found. below, provides a general overview of the process/phases, and applies whether a Customer is seeking a new connection, altering an existing connection or looking to install solar or other forms of alternative sources of supply.

The timeframes for each phase can vary depending on the type, scale and complexity of any given proposal. Simple LV supplies may only take a few weeks for Peel to provide a Connection Offer and may require only minimal physical work. Very large or complex connections could take a number of months to discuss, consider, assess and finalise a specific Connection Offer prior to acceptance. Detailed design and construction may take several months or more depending on project complexity and equipment lead times.

3.7.2 Application Phase

The initial application phase will generally involve the following activities:

- Customer, Customer's Agent and/or their appointed electrical contractor/consultant:
 - considers specific self-supply arrangements and installation requirements
 - arranges initial discussions with Peel regarding applicable options/arrangements
 - plans/finalises initial proposals and submits application with relevant details to Peel.
- Peel will then:
 - review the application and request any additional information if required
 - consider extent of assessments and fees required to prepare an offer/quotation (if any)
 - discuss and/or request additional details if necessary, and request payment of fees to prepare an offer/quotation.

In simple cases, Peel may be in a position to start preparing an offer/quotation immediately after the initial application has been submitted. For more complex situations, confirmations and additional information may be required including:

- Confirmation of contact details
- Confirmation of electrician or other representative details
- Clarification of anticipated timing, loading, output and operating details
- Details of proposed capacity(kW) and frequency/voltage control details
- Proposed site layouts and connection arrangements
- Proposed electrical phasing, impedance and protection details
- Details of generated power quality and reactive power capability/control
- Inverter, rectifier, variable speed and control system details.

Where required Peel will send a written request for the additional information and may also request payment of initial fees to prepare an offer. These fees will depend on the complexity/scale of the assessment and extent of work likely to be required (refer to Section **Error! Reference source not found.** for further details).

The WA Electrical Requirements (WAER) outline the technical requirements for electrical installations and should be considered in detail when planning electrical facilities. Typical details for the different types of supply available from the Peel Microgrid are also provided in Section

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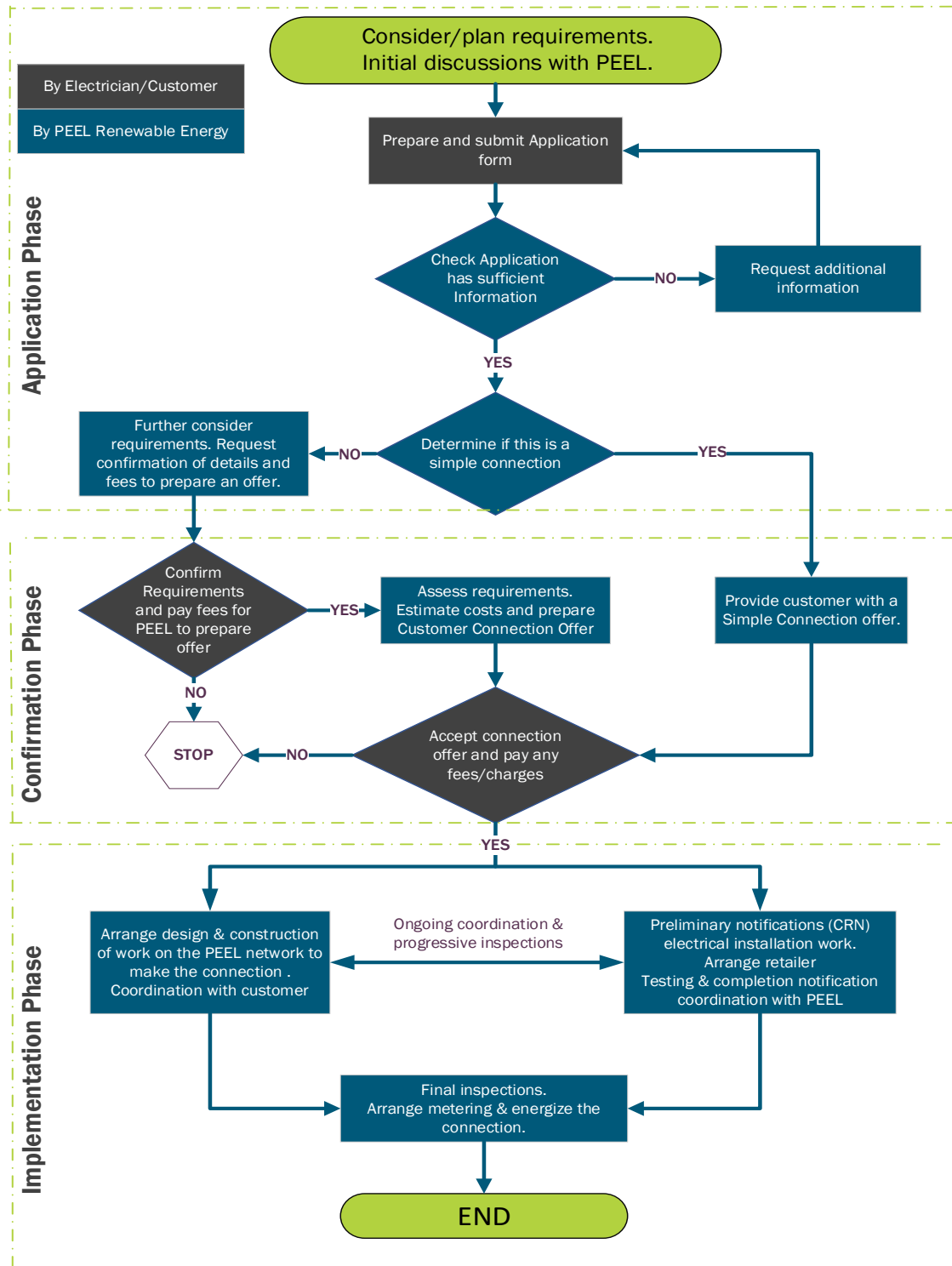


Figure 2 - Connection Process Overview

3.7.3 Review and Confirmation Phase

Once the proponent (or their agent) has provided all requested information and paid the applicable fees, Peel will commence the review to confirm the required arrangements and prepare an offer/quotation. For simple situations this may only take a few weeks. For large or complex situations, a range of detailed assessments may be required including (but not limited to):

- A review of capacity and any upgrading requirements on the Peel Microgrid, and upstream WP Network
- Assessment of protection systems and related requirements
- Review of potential impact on WP Network voltages and regulation
- Implications for supply reliability, power quality and power factor
- Arranging associated assessments by Western Power (where required)
- Determining any specific operating conditions that may need to be imposed
- Finalising a preferred connection arrangement, concepts and estimated costs.

Peel will use its best endeavours to provide an offer within three months of receiving all relevant information (with significantly shorter timeframes in less complex situations). An invoice for associated payment of charges may also be included which will typically involve an initial deposit of 20%, followed by the remainder 30 days prior to the commencement of construction (subject to scale of works).

The Connection Offer will also include an expiry date (typically 60 days from the date of the Connection Offer) within which it should be accepted, including payment of any associated deposit or charges.

3.7.4 Implementation Phase

Detailed design and installation can commence after acceptance of the Connection Offer. Peel will arrange design and construction of connection and augmentation work required on the Microgrid. The customer's electrical contractor will be responsible for all work within the electrical installation, including any associated private incoming mains and submitting necessary preliminary notifications with CRN.

The electrician/project manager will need to maintain regular contact with Peel during both design and construction to ensure suitable coordination is achieved throughout the development of the installation and associated connection. Any remaining fees or charges will also need to be paid as stipulated in the Connection Offer.

The customer or their electrician will also need to pre-arrange associated metering installation to ensure it is ready for final energisation.

Suitable testing and completion notifications are required prior to connection and are the responsibility of the customer's electrician/agent. Notifications should be submitted to Peel at the earliest opportunity to help avoid delays. Notification requirements may depend on type of work involved and will generally require certification from a suitably licensed electrician and/or professionally qualified electrical engineer.

The WA Electrical Requirements (WAER) details technical requirements for electrical installations and should be considered in detail during the design and construction of the customer's electrical installation.

3.7.5 Application Process and Forms

The general process outlined above applies to all self-supply connections within the PBP, with associated applications typically requiring the following initial information:

- Electrician or other representative details (if known)
- Existing or proposed location of applicable premises/facilities
- Estimated date when connection is initially required
- Type of generation/self-supply system
- Estimate of maximum kW generating capacity
- Initial estimate of annual MWh energy to be generated (if known)
- Other relevant information that might be available, such as equipment details, operating times and any special requirements.

General steps and detailed requirements are also consistent with the WADCM, and in particular the following clauses:

- 7.18 Process for LV distribution connections.
- 7.19 Connection process for HV supply.
- 7.20 Application processes for inverter energy systems.
- 15.3.3 Peel Connection applications.

3.8 WA Distribution Connections Manual

The following clauses of Section 13 of the WA Distribution Connections Manual (WADCM) equally apply to self-supply facilities within the Peel Business Park:

- 15 Alternative sources of supply or generation
- 15.1 Definitions: including all subclauses
- 15.2 Generation categories: also noting types of systems as defined in S these Guidelines
- 15.3 Customer/agent responsibilities: including all associated subclauses
- 15.4 Customer equipment and appliances
- 15.5 System designers and installers
- 15.6 Generation license requirement
- 15.7 Connection arrangements: including all subclauses
- 15.9 Fault Protection
- 15.9 Interlocks and change over
- 15.10 Islanding prevention and protection schemes
- 15.11 Metering, monitoring, control and data-acquisition: noting export and buy-pack tariffs will not generally apply,
- 15.12 Power Quality: including all subclauses and noting applicable information included in these Guidelines
- 15.13 Labelling,
- 15.14 Commissioning and maintenance: including all subclauses,
- 15.15 Additional requirements for parallel connected generation: including all subclauses and noting applicability of these Guidelines to the Peel Microgrid,
- 15.16 Additional requirements for inverter connected generation: including all subclauses,
- 15.17 Portable Generation systems

3.9 Appointing an Electrical Consultant/Contractor

In large or complex situations, it may take a number of months for detailed requirements to be determined and finalised so that any necessary connection and installation work can commence. The services of suitably qualified and experienced consultants, contractors and/or personnel should be enlisted as early as practical in the process to help ensure successful and timely outcomes.

3.10 Notifications of Electrical Work

A range of statutory obligations/requirements apply to notification of electrical work, as outlined in Section 8 of the WA Distribution Connections Manual (WADCM). These requirements equally apply to all electrical work undertaken within the Peel Business Park.

3.11 Contract Administration

The customer has a range of obligations in the establishment and management their connections. Related works for which they are responsible shall be undertaken in accordance with the applicable design and technical requirements. Requirements for associated contract administration including, project management, timing/scheduling, warranties and documentation are consistent with the WA Distribution Connections Manual (WADCM), and in particular clause 7.5 (Contract Administration).

3.12 Commercial Matters, Tariffs, Fees and Charges

Peel's charges for processing connection applications are addressed in the *Customer Connection and Contribution Guidelines (CCCG) (Peel)* BMSDOC-18-2203.

A pre-condition to Peel's consent to connecting generation is the Customer and Peel's entry into the Self Supply Contract. A copy of the Self Supply Contract is available from Peel's website.

4. TECHNICAL INFORMATION AND REQUIREMENTS

4.1 Overview

This Section 4 provides applicable technical information and requirements for self-supply facilities within the Microgrid. This information is provided principally for use by electrical contractors, consultants, designers and workers to and describes the technical details/requirements that must be understood/satisfied when connecting and operating these facilities.

The applicable connection arrangement and more specific information for any given situation will be determined and described by Peel, in consultation with the customer and/or their agent, following the connection and application processes outlined in Section 3.5.

4.2 Technical Considerations

Key technical matters that will need to be considered when planning and assessing the connection of self-supply facilities to the Microgrid include:

- Network capacity (including the connections, the Microgrid and upstream WP network)
- Generator hosting capacity
- Network voltages including voltage step, regulation and stability
- Power factor and reactive power control
- Impact on short-circuit fault levels and associated current flows
- Protection matters including:
 - Preventing back-feed/export and inadvertent islanding
 - Short circuit fault protection
 - Synchronisation
 - Avoiding generator damage.
- Impacts on power quality (e.g. harmonics, flicker and voltage unbalance)
- Network stability (typically for large generators)
- Associated network modelling and system studies.

These considerations are important for safe operation and to ensure the Microgrid performs in accordance with relevant criteria, as outlined in the *Peel Business Network Performance and Planning Criteria Manual - NNPC (Peel)* [BMSDOC-18-2210].

Relevant sections of WP Technical Rules and WP Guidelines for Connection of Generators also describe the related WP requirements that need to be considered and satisfied by the Microgrid, and associated generation facilities.

4.2.1 Network Capacity

As power export on customer connections is not generally permitted, capacity within the Microgrid is not required to cater for exported power flows. This will generally avoid the need to upgrade network capacity for the purpose of connecting site generation. Furthermore, during operation self-supply facilities may reduce network loading and the draw of power from the Microgrid.

However, customers should be aware that generating systems will normally have significantly lower levels of availability than the Microgrid and could also trip off-line at any time due to a range of causes. Accordingly, sufficient network capacity will always be required to service load when self-supply facilities are under low output or off-line. For these reasons, customers should not assume the capacity (or cost) of their connection can necessarily be reduced, without first accepting a potential compromise to availability and reliability of supply.

4.2.2 Hosting Capacity

It follows that at any time, site generation must be no greater than site load to avoid power export. The maximum generator hosting capacity for a given connection will therefore depend on load, taking into account the specific generation and site consumption characteristics. Other factors such as voltage effects and fault ratings/limits could also influence generator sizing in any given situation. These considerations should all be taken into account when determining appropriate generator sizing.

4.2.3 Voltage Effects

Voltages on the Peel Microgrid must be maintained within a specific set of limits as detailed in the PBP *Network Performance and Planning Criteria Manual - NNPC (Peel)* [BMSDOC-18-2210]. All generating facilities operating in parallel with the Microgrid must have suitable capability and control to ensure relevant voltage limits are not breached. Reactive power capability may be an important factor in meeting these limits as described further in section 4.2.4.

Furthermore, in the event a generator operating in parallel with the Microgrid is suddenly connected or disconnected (e.g. trips off-line), any resulting step change in network voltages must also be maintained within prescribed limits. Larger generating units may have greater difficulty meeting these limits subject to location and specific details.

4.2.4 Power Factor

The Peel Microgrid is generally required to maintain a power factor between 0.9 lagging and 0.9 leading on the upstream Western Power connections. This will typically require customers supplied from the Microgrid to also maintain their power factor within similar limits.

Any generators operating in parallel with the Microgrid could disproportionately affect the power factor for both the customer and the Microgrid, particularly where generators operate at unit power factor (i.e. KWs only). For this reason, Peel will require parallel generation to have suitable reactive power and control capabilities that ensure power factor limits are maintained.

4.2.5 Short Circuit Faults

Generators operating in parallel with the Microgrid may significantly increase short-circuit fault levels and affect associated current flows and protection. This affect equally applies to non-exporting generators.

Customer's must ensure their electrical installation, facilities and equipment are suitably designed to withstand and protect against short circuit faults both with and without their generators in-service. Impacts of increased fault levels on associated electrical arcing hazards may also need consideration.

Installation of any self-supply facilities will also be conditional on the fault level limits and protection requirements of the Microgrid being satisfied, as outlined in the *Network Performance and Planning Criteria Manual - NNPC (Peel)* BMSDOC-18-2210.

Customer's should also be aware that short-circuit faults elsewhere on the Microgrid or upstream WP network, may affect generator operation and protection systems that are sensitive to disturbances (such as VVS and ROCOF schemes). This could result in the generator(s) tripping off-line for faults/disturbances

elsewhere on the network. Customers should ensure their facilities are suitably designed to cater for such events, which can occur at any time.

4.2.6 Network Protection

Generators and other supply-self facilities have a range of protection requirements. Specific details will depend on the size/type of generation as well as the connection and installation arrangements. The customer is responsible for ensuring suitable systems are provided to protect their installation and comply with the WA Electrical Requirements.

The customer is also responsible for ensuring requirements specified by Peel during the application/connection process including applicable schemes, redundancy, technical details and related testing/commissioning requirements. The range of protection schemes that might typically be required for connecting generators to the Microgrid are given below:

- Short-circuit protection (OC and EF) (also refer Section 4.2.5)
- Directional power protection (export inhibit)
- Synchronisation checking
- Suitable anti-islanding protection (e.g. ROCOF and/or VVS)
- Under and over voltage protection (UV/OV)
- Under and over frequency protection (UF/OF)
- Neutral voltage displacement (NVD) (subject to earthing details)
- Pole-slip (out-of-step) protection.

4.2.7 Power Quality

Self-supply/generation facilities must be designed and installed to ensure applicable power quality limits are not exceeded including harmonic distortion, rapid voltage fluctuations (flicker) and voltage unbalance (negative sequence voltages). The PBP *Network Performance and Planning Criteria Manual - NNPC (Peel)* [BMSDOC-18-2210] describe the overall power quality planning limits that apply to the Microgrid.

Customer's will be required to manage their emissions to levels that do not cause the Microgrid planning limits to be exceeded. Peel may allocate a specific set of emission limits to individual customer's where necessary, and may also require customers to instigate testing, investigations and appropriate mitigation measures in situations where power quality limits are exceeded.

4.2.8 Network Stability

The issue of broader network stability typically applies to larger generating systems and is not likely to affect the smaller systems expected within the Peel Business Park. None-the-less network stability (including voltage stability) may need to be considered and managed in some cases, particularly where larger generating system are proposed, or where the combined generation capacity within the Microgrid exceeds applicable stability limits. Peel reserves the right to deny a connection to the Microgrid in situations where network stability and/or compliance with the WP Technical Rules could be compromised.

4.2.9 Network Studies

Proponents and Peel may be required to undertake a set of detailed network studies to assess compliance and determine applicable requirements for the connection of self-supply facilities to the Microgrid including:

- Steady state load flow, voltage and contingency analysis
- Short-circuit fault and protection studies
- Dynamic, transient and voltage stability studies
- Harmonic and voltage flicker assessments

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- Motor starting simulations
- Electrical arcing hazard assessments.

To undertake necessary studies, Peel may require a range of information to be provided and confirmed by proponents at various stages during the application process including, but not limited to:

- Proposed layouts and single line diagrams for the electrical installation
- Installation parameters, including ratings, impedances, operating voltages, earthing and phasing/vector group details for all key elements such as conductors/cables, switchgear, power transformers and any proposed generation details
- Real and reactive loading details as well as details of power quality emissions where applicable (e.g. flicker, harmonics, phasing, negative sequence and step-load parameters)
- Details of proposed protection equipment/devices, including fuses, CT's, VT's, protection relays and associated settings.

It is the customer's responsibility to ensure the accuracy of information provided and arrange any necessary technical studies for their electrical installation.

4.2.10 Aggregated Generation Capacity

In situations where the aggregated installed capacity of generation across the Peel Microgrid exceeds applicable thresholds defined in Section 3.2, then suitable studies and requirements will be necessary to satisfy applicable requirements of Western Power for each category. In these situations, customers with self-supply facilities may be required to furnish additional relevant information and assist in meeting any applicable requirements.

4.3 Connection Agreements

All connections to the Peel Microgrid will be through underground (UG) services. Given the nature of development, connection arrangements will vary depending on specific requirements and voltage. The different types of connection that have been defined based on physical arrangement are listed below:

Low Voltage Supplies

- District Substation - Shared Street Circuit
- District Substation - Dedicated Circuit(s)
- Sole Use Substation - Dedicated Circuit(s)

High Voltage Supplies

- Ground mounted Ring Main (Outdoor)
- Ground mounted Ring Main (Indoor)
- Dedicated Feeder

General arrangements will be based on the underground LV and HV supply configurations described in Sections 8.1.5 and 8.1.7 of the WP Distribution Customer Connection Requirements.

Further details and information for each type of connection is provided in the *Customer Connection and Contribution Guidelines (CCCG) (Peel)* BMSDOC-18-2203. these Guidelines also outline implications for the various types of alternative supply systems.

4.4 Standby System Requirements

4.4.1 General

By definition standby systems do not involve parallel operation with the Microgrid. These systems are typically installed to provide a separate alternative supply in the event network supply is interrupted or unavailable for extended periods (e.g. emergency supplies). System type, details and capacity may vary widely subject to specific requirements.

4.4.2 Technical Requirements

All standby systems will require suitable interlock and/or change-over facilities that prevent parallel operation with the Microgrid. Systems must be installed in compliance with State Regulator (Energy Safety) requirements, as well as all relevant standards and regulations, and in particular AS/NZS 3010 and the WA Electrical Requirements (WAER).

4.4.3 Connection Agreements

Standby systems may be considered for all types of connection outlined in Section 4.3, and should have minimal impact on associated requirements provided suitable interlocking and/or changeover facilities are provided.

4.4.4 Application Requirements

Despite non-parallel operation, Peel review/approval for the connection of standby systems to the Microgrid is necessary, principally to review installation interlocking and changeover facilities. This will typically be straightforward and follow the simple connection process path described in Section 3.7. Application forms are listed in Appendix 1.

4.5 Small Inverter Energy System Requirements

4.5.1 General

Small inverter energy systems (SIES) are AS 4777 compliant systems rated up to 10kVA single phase and 30kVA three-phase connected at LV. This will typically be for small rooftop PV solar installations but may apply to battery installations and other energy sources. The 10kVA per phase limit applies across the whole electrical installation.

4.5.2 Technical Requirements

By definition SIES systems must utilise inverters complying with AS 4777.2 and installed in compliance with AS4777.1, as well as all other relevant standards and regulations, and in particular AS/NZS 3000 and the WA Electrical Requirements (WAER). Associated inverters must be included on the Clean Energy Council approved inverters list.

The system must incorporate a suitable scheme and settings that will prevent any export of power from the electrical installation connection to the Microgrid at all times. Settings shall be suitably secured against unauthorised changes per AS 4777.1.

The following clauses within the WP Technical Rules are particularly relevant and apply to all SIES systems within the Peel Microgrid:

- 3.7.1 Scope
- 3.7.1 Energy System Capacity, Imbalance and Assessment
- 3.7.3 Relevant Standards
- 3.7.4 Metering Installation: noting export does not generally apply
- 3.7.5 Safety: including all subclauses
- 3.7.6 Circuit Arrangements: including all subclauses
- 3.7.7 Protection: including all subclauses
- 3.7.8 Commissioning and Testing: including all subclauses
- 3.7.9 Signage.

The relevant clauses of the WA Distribution Connections Manual, as listed in Section 3.8 of these Guidelines, also apply to SIES systems within the Peel Microgrid and in particular:

- 15.16 *Additional requirements for inverter connected generation: including all subclauses.*

4.5.3 Connection Arrangements

SIES systems might typically apply to shared street circuit LV supplies, but could apply for all types of LV connections outlined in Section 4.3. They should have minimal impact on associated connection requirements provided suitable inverters, settings and installation arrangements are provided.

4.5.4 Application Requirements

Peel review and approval for the connection of all SIES systems to the Microgrid is necessary, principally to review inverter and installation requirements noted above. This should typically be straightforward and follow the simple connection process path described in Section 3.7. Application forms are listed in Appendix 1.

4.6 Other Small System Requirements

4.6.1 General

Other Small Systems (SS) as defined in Section 3.2, encompasses all alternative self-supply facilities less than 10MW, excluding the SIES and Standby systems described above. This includes all Inverter Energy Systems (IES) greater than 10kVA per phase, as well as rotating generators and all other forms of self-supply. The less than 10MW limit applies across the whole electrical installation.

The majority of self-supply facilities within PBP are expected to fall into this category with PV Solar installations likely to predominate.

4.6.2 Technical Requirements

All systems must comply with all applicable standards, regulations and the WA Electrical Requirements (WAER). Inverter Energy Systems (IES) within this category should also generally comply with AS 4777. Inverters should be included on the Clean Energy Council approved inverters list (or have a suitable type-test report certifying compliance with AS/NZS 4777 from a recognised and independent certifying authority).

All systems must incorporate a suitable protection scheme and settings that will prevent any export of power from the electrical installation connection to the Microgrid at all times, with settings suitably secured against unauthorised changes.

The following clauses within the WP Technical Rules are particularly relevant and also apply to all SS systems within the Peel Microgrid:

- 3.6.1 Overview
- 3.6.2 Categorisation of Facilities: noting only 22kV applies to HV connections and export of power does not apply within PBP
- 3.6.3 Information to be provided by the Generator
- 3.6.4 Safety and Reliability
- 3.6.5 Requirements of clause 3.3 applicable to small power stations
- 3.6.6 Generating unit characteristics
- 3.6.7 Connection and Operation: including all associated subclauses
- 3.6.8 Power Quality and Voltage Change: and noting the performance criteria described in the PBP NP&PCM
- 3.6.10 Protection: including all associated subclauses, and noting export protections must be provided that prevent export
- 3.6.11 Inter-tripping
- 3.6.12 Failure of Generator's Protection equipment
- 3.6.13 Commissioning and Testing
- 3.6.14 Technical matters to be coordinated.

The relevant clauses of the WA Distribution Connections Manual as listed in S these Guidelines, also apply.

In addition to the requirements above, where the aggregate generation capacity across the Peel Microgrid is 10MW or greater, additional provisions may be required for customer self-supply facilities to help satisfy Western Power's Large Generator requirements (as described in Section 3.3 of the WP Technical Rules).

4.6.3 Connection Agreements

Other Small Systems may have a wide range of ratings (i.e. 10kVA to 10MW) and could apply across all defined connection types. Based on typical load limits for each type of connection, Table 3 provides indicative PV Solar capacity limits to avoid export (based on generic commercial load during normal operating times only). Actual limits for any given situation will vary subject to specific details and nature of the load and customer facilities.

Table 3: Indicative PV Solar Hosting Limits

Voltage	Type of Supply	Indicative PV Solar Hosting Limits*	
LV	District Substation - Shared Circuit	<120kVA	
	Shared District Substation Dedicated Circuit	Single-Fuse	<150kVA
		Double-Fused	<240kVA
		Disconnecter	<480kVA
	Sole Use Substation	Single-Transformer	<480kVA
		Dual-Transformer	<960kVA

HV connections will typically apply to any installations with self-supply capacity exceeding 1MW.

Various layout arrangements will generally be consistent with the underground configurations described in the following sections of the WP Distribution Customer Connection Requirements.

- 8.1.5 LV District Substations
- 8.1.7 HV Connected customer owned substations.

4.6.4 Application Requirements

Application requirements for SS systems will vary subject to size and specific details.

Smaller installations (typically below 150kVA) may generally be more straightforward as far as analysis and information is concerned and will typically involve the following:

- Assessment of protection systems and related requirements
- Implications for supply reliability, power quality and power factor
- Determining any specific operating conditions that may need to be imposed
- Finalising a preferred connection arrangement, concepts and estimated costs.

Peel may typically require following information during the application process:

- Proposed layouts and detailed single line diagrams for the electrical installation
- Real and reactive loading details as well as details of power quality emissions (e.g. flicker, harmonics, phasing, negative sequence and step-load parameters);
- Details of proposed protection equipment/devices, including fuses, CT's, VT's, protection relays and associated settings.

Larger installations (typically above 150kVA), will generally require more detailed assessment which may also include impacts on aggregated generator capacity, upstream Western Power network as well as fault level impacts, network voltages, regulation and stability. More detailed information and analysis will generally be required as outlined in Section 4.2.

In all cases, the full connection process described in Section 3.7 will need to be followed.

4.7 Large System Requirements

4.7.1 General

The vast majority of self-supply facilities within PBP are expected to fall into the Small System category described above. Large self-supply proposals exceeding 10MW capacity would be particularly unusual and generally incompatible with the nature of the Microgrid.

In exceptional circumstances Peel may consider Large generation proposals, which would also require extensive coordination with Western Power. Such facilities would be required to participate in the Wholesale Electricity Market with a range of associated requirements that are outside the scope of this document.

4.7.2 Application and Connection

Any large generators proposals that are considered will require connection at high-voltage with a set of specific arrangements to be determined through the application process described in Section 3.7.