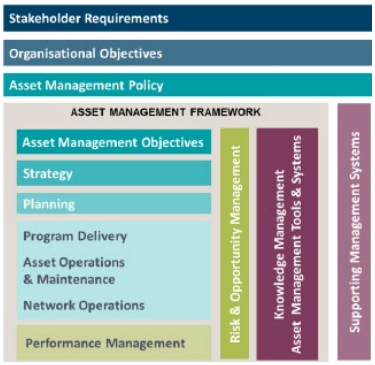
Transmission

Customer Connection Requirements



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RESPONSIBILITIES

Western Power's Grid Transformation Function is responsible for this document.

CONTACT

Western Power welcomes your comments, questions, and feedback on this document, which can be emailed to standards.excellence@westernpower.com.au

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Revision Details

Revision No.	Date	Summary of change	Section
1	1/06/2024	Original Issue	

Contents

1. Introduction

This document provides the functional requirements for transmission connections, and guides both Western Power and *Users* when connecting a generator, load or storage system to the Western Power transmission network. This includes:

a. establishment of a new connection between a *User*'s *facility* and the Western Power Network; or

b. material modification of facilities and equipment connected at an existing connection point.

It should be noted that there are a variety of connection arrangements on the Western Power network because of historical network development. Western Power does not consider that these set a precedent for future connection arrangements.

For further information on the connection process please refer to Western Power's website or contact Western Power at network.access@westernpower.com.au.

1.1 Objective

The objective of this document is to provide Western Power's functional requirements for new transmission connections which:

- provide network security and reliability;
- deliver effective and practicable transmission connection outcomes;
- comply with the relevant legal and regulatory obligations; and,
- ensure the safety and integrity of Western Power and *User* assets.

1.2 Acronyms

Acronym	Definition
BESS	Battery Energy Storage Systems
CB	Circuit Breaker
CMS	Customer Main Switch
CP	Connection Point
CT	Current Transformer
ENAR	Electronic Network Access Request
FCESS	Frequency Co-optimised Essential System Services
FOR	Forced Outage Rate.
GPS	Generator Performance Standards
POCC	Point of Common Coupling
SWIN	Southwest Interconnected Network
SWIS	Southwest Interconnected System
SWISDA	SWIS Demand Assessment
TSP	Transmission System Plan
UOP	User Operating Protocol
VT	Voltage Transformer
WEM	Wholesale Electricity Market
WOSP	Whole of System Plan

1.3 Definitions

Term	Definition
augmentation	The meaning given in the Access Code
connection asset	The meaning given in the Access Code
connection circuit	Part of the transmission system between the CMS and the point of common coupling
connection point	The meaning given in the Access Code
Customer	The meaning given in the Access Code. For the purposes of this document, this term is used to cover all customers including both Transmission Users as well as other consumers serviced by Western Power.
Customer Main Switch (CMS)	The circuit breaker that is operated when the User wishes to disconnect their equipment from Western Power's transmission network. This is normally owned by the User but may be owned by Western Power providing there is adherence to Technical Rules clause 3.2.2.
distribution system	The meaning given in the Technical Rules
facility	For the purposes of this document, a generator, load or storage system
good electricity industry practice	The meaning given in the Access Code
infeed loss risk limit	The maximum allowable loss of power infeed to remain within the Frequency Operating Standard as defined in WEM Rules. For purposes of transmission system design and planning, the maximum infeed loss risk limit is 400 MW. The loss of power infeed may only exceed this value if it has been analysed an approved by Western Power and AEMO.
loss of power infeed	The loss of power infeed resulting from a credible contingency on the transmission system shall be calculated as follows: (1) the sum of the capacities of the generating units disconnected from the power system by the credible contingency, plus (2) the planned import from any external systems disconnected from the power system by the same event, less (3) the forecast minimum demand disconnected from the power system by the same event but excluding: (A) any demand that may be automatically tripped for frequency control purposes on the power system; and (B) the demand of the largest single *User* within the group.
meshed substation	For the purposes of this document, interpretation of Technical Rules clause 3.3.3.10(c)(2) shall be one with a switchable busbar at 132 kV (via one or more bus section circuit breakers) or with bus coupler circuit breakers between busbars (e.g. breaker and a half arrangement), where a credible contingency on the User's side of the CMS or a circuit breaker failure of the CMS does not result in the disconnection of other generation, load or storage from the network.
point of common coupling	The meaning given in the Technical Rules
terminal station	A major transmission station on the network with characteristics which include one or both of: • transforms electricity between two or more transmission system voltages and which supplies electricity to zone substations • all 330kV and 220kV substations including switchyards
switchable busbar	A busbar that includes series circuit breakers, intended to connect, or disconnect two or more sections of that busbar under load or fault conditions.
transmission circuit	Part of the transmission system between two or more circuit breakers, which may include overhead lines, underground cables, and transformers but excludes busbars and connection circuits.
transmission line	The meaning given in the Technical Rules

	In this document transmission line refers to an overhead line or underground cable connecting a generator, load or storage system to a terminal station, substation, or existing transmission circuit.
transmission system	The meaning given in the Technical Rules
User Operating Protocol	A document that captures the operational arrangements between a User and Western Power.
User	The meaning given in the Technical Rules
zone substation	The meaning given in the Technical Rules

1.4 References

References which support implementation of this document

Reference	Title
On line	Western Power Technical Rules
On line	Wholesale Electricity Market Rules
On line	Transmission System Plan and Network Opportunities Map
On line	Whole of System Plan
On line	SWIS Demand Assessment 2023 to 2042
On line	Electricity Industry Metering Code 2012
On line	Electricity Networks Access Code
On line	Transmission loads & large generators (westernpower.com.au) (Major Customers)

1.5 Context

This document forms part of a suite of network functional requirements documentation applying to the Western Power transmission network. Therefore, these Customer Connection Requirements must be read in conjunction with the relevant Western Power functional requirements standards, and any applicable laws, regulations, codes, and standards to ensure that generic, and specific, contexts are identified and addressed in full. The documents are available publicly via Western Power's web site. Additional information can be obtained through the appropriate Western Power technical information[1] and connections[2] portals.

The contents of this Standard are not substitutes for any requirements pursuant to the applicable laws. To the extent they conflict, the contents herein should be read subject to being subordinate to written legislation and associated statutory objects, such as regulations, rules, codes, requirements, or guidelines.

[1] Manuals, guides & standards (westernpower.com.au)
[2] Major customer connection review (westernpower.com.au)

2. Requirements

2.1 General

Transmission connections must be consistent and compatible with the current Western Power network topology and future development of the network in accordance with *good electricity industry practice*.

Any new network or modified existing connections shall:

a. not adversely affect power system security, reliability, or quality of supply;

b. comply with the switching and isolation requirements of the network and not have a material negative impact on the time required to isolate, earth, and maintain the network under planned or unplanned activities; and,

c. seek to minimise any reliability or quality of supply impacts to other *Customers*.

The *User* must consult with Western Power and agree with the asset management requirements for all *connection assets* which are Western Power owned, operated, and maintained. This must include requirements such as spares, maintenance, post fault recovery timescales and asset operation.

The ownership, configuration, operational boundaries, and maintenance responsibilities for all *connection assets* must be agreed and recorded in the *User Operating Protocol* (UOP). The UOP document will be developed by Western Power during the connection process and be agreed with the *User* prior to commissioning of the *connection assets*. It will remain a live document, managed by Western Power and updated in consultation with the *User* as and when required.

All *connection assets* owned by the *User* must be subject to an asset management regime which is equivalent to that used by Western Power to manage its own transmission assets.

Western Power require the *User* to indemnify Western Power from all liability for any direct or indirect damage caused to the *User* because of the *User* electing to use a Western Power circuit breaker to clear a fault on assets not owned by Western Power.

The *User* must ensure it carries out due diligence regarding potential power system and network constraints. This must include any impact on the Essential System Services market due to loss of load/generation from a single credible contingency as defined in the Technical Rules.

2.2 Connection Principles

A proposed network connection shall meet the connection principles outlined below.

2.2.1 Principle 1

The configuration of the connection arrangement for a proposed new *facility* must:

a. not adversely affect power system security.

b. not adversely affect the quality of network services to other *Customers*.

c. be otherwise consistent with *good electricity industry practice*.

2.2.2 Principle 1 - specific design requirements

a. The occurrence of a credible contingency event on the *User* side of the *CMS* resulting in the operation of the *CMS* should not result in:

(i) disconnection of any other *Customer's facility*; or,

(ii) any interruption to the provision of transmission services to other *Customers*.

b. The failure of a protection device or *CMS* circuit breaker (designed to clear faults on *User* owned equipment) to operate correctly when required and the subsequent operation of the related circuit breaker-fail protection should not result in:

(i) an adverse effect on power system security; or,

(ii) the disconnection of any other *Customer's facility*.

c. The configuration of all new 'Cut In Cut Out' connections to the *transmission system*, other than network planned to a N-0 criteria (i.e. radial), must be designed with a *meshed substation* configuration. In addition, they shall be no greater than 2.5 km from the existing *transmission line* being interconnected.

d. 'Tee' connections are only permitted under the following circumstances to minimise the adverse impacts upon the safe, secure, and reliable operation of the power system:

(i) 132kV and below;

(ii) only one Tee connection per *transmission line* will be allowed. The maximum capacity will be nominally 150 MW for dispatchable facilities and will be subject to an operational acceptability assessment as outlined in 2.2.3 and 2.2.4;

(iii) maximum length of the Tee connection line from existing *transmission line* to the *connection point* is 10% of the line being teed into, or 5 km (whichever is less);

(iv) *Users* are obliged to disconnect their tee connected *facility* as required for Western Power to access the line for maintenance purposes;

(v) for network planned to an N-0 criteria (i.e. radial), a Tee connection will only be permitted where there is no more than one existing transmission connected *User* on the network;

2.2.3 Principle 2

Generation connections

Generation connections shall be planned such that:

a. In general, during the planned outage of any single section of Western Power busbar, the maximum reduction of generation capacity shall be 150 MW. The capacity and quantity of transmission connections on a bus section will be subject to an operational acceptability assessment.

b. following a credible contingency without a planned outage (as per **Table 1**), the *loss of power infeed* shall not exceed the *infeed loss risk limit*;

c. following a credible contingency with a planned outage (as per **Table 1**), the *loss of power infeed* shall not exceed the *infeed loss risk limit* - it can be assumed that generation can be constrained to meet this limit for the duration of the planned outage.

Table 1

Credible Contingency	Planned Outage
Single transmission circuit	None
Single connection circuit	
Single section of busbar	
Single busbar coupler CB	
Single busbar section CB	
Single transmission circuit	single *transmission circuit* or single section of busbar
Single section of busbar	
Single busbar coupler CB	
Single busbar section CB	

Load connections

d. Load connections shall be planned in accordance with the permitted loss of demand for the listed credible contingencies as shown in Table 2.

Table 2

Aggregate Peak Demand (Load)	Credible Contingency	Following Credible Contingency	Following Credible Contingency and Planned Local Outage
		Permitted Loss of Demand	
≤ 90 MVA	*Transmission circuit* ¥	None	Up to 90 MVA
> 90 MVA & ≤ 250 MVA	*Transmission circuit* Busbar	None	Up to 250 MVA*
> 250MVA	*Transmission circuit* *Connection circuit* Busbar	None	None

* It can be assumed that load can be reduced to meet the network constraints for the duration of the planned or unplanned outage

¥ This is not applicable to a radial *transmission circuit*

Storage system connection

e. Storage system connections when charging shall be planned in accordance with the permitted loss of demand for the listed credible contingencies as shown in Table 3.

f. Storage system connections when discharging shall be planned in accordance with 2.2.3 Generation connections.

Table 3

Aggregate Peak Demand (charging BESS)	Credible Contingency	Following Credible Contingency	Following Credible Contingency and Planned Local Outage
		Permitted Loss of Demand	
≤ 150 MVA†	*Transmission circuit* ¥	None	Up to 150 MVA†
> 150 MVA† & ≤ 250 MVA	*Transmission circuit* Busbar	None	Up to 250 MVA*
> 250MVA	*Transmission circuit* *Connection circuit* Busbar	None	Up to 250 MVA*

* It can be assumed that dispatchable load when charging can be constrained to meet this limit for the duration of the planned or unplanned outage

† Nominal value only – subject to operational acceptability assessment

¥ This is not applicable to a radial *transmission circuit.*

2.2.4 Principle 2 - specific design requirements

Generation connections

a. The capacity of a generator system permitted to connect on a single section of busbar shall be such that the maximum aggregate generation on that busbar section is nominally 150MW up to a maximum of 300MW on a single busbar site. Also, in general, only one transmission *User* will be permitted to connect to a single section of busbar. These limitations will be subject to an operational acceptability assessment which will also include:

   (i) the ability to coordinate planned outages;

   (ii) power system security and reliability impacts;

   (iii) network voltage control capability.

b. The *loss of power infeed* connected to any single circuit shall not exceed the *infeed loss risk limit*. Exceptions may be considered subject to approval by Western Power and AEMO following an impact assessment.

c. When the *loss of power infeed* exceeds the *infeed loss risk limit*, additional circuits may be required to meet the planned outage and contingency combinations in Table 1.

Load connections

d. the maximum aggregate load that is permitted to be connected to a busbar section that would be taken out of service during an unplanned busbar outage is 90 MVA. This includes reasonably foreseen forecast load due to existing connections; and,

e. the maximum capacity of a load system permitted to connect via any single connection circuit shall be 250 MVA.

Storage system connections

f. the maximum BESS charging load (including aggregate load) that is permitted to be connected to a busbar that would be taken out of service during an unplanned busbar outage is 150 MVA. This includes reasonably foreseen forecast load due to existing connections.

g. the maximum BESS charging load permitted to connect via any single connection circuit shall be 250 MVA

h. the maximum BESS discharge shall be as for Generation connections in 2.2.4

2.2.5 Principle 3

The configuration of the connection arrangement for a new *facility* must be designed in a manner which enables the establishment of protection systems which are compatible with existing Western Power systems; and can be operated in a manner which is consistent with *good electricity industry practice* and complies with the requirements of the Technical Rules.

2.2.6 Principle 3 - specific design requirements

a. The party that owns the *transmission line* between the new *facility* connection and Western Power network shall own, operate, and maintain the line protection & control scheme, secondary equipment, and the communication system including communication channels.

b. Western Power shall own, operate, and maintain all the primary plant required for the protection system (CB, CT, VT & disconnector/earth switch) at Western Power substations.

c. Where the *transmission line* protection system is owned by the *User*, Western Power shall implement additional protection for the *transmission line* (in a Western Power owned protection panel inside Western Power substation), for the case of a fault not being adequately cleared by the *User's* protection.

d. The design of any protection system which is required to be established as part of the proposed connection arrangement for a new *facility* must:

   i) be compatible with existing Western Power systems.

   ii) be designed and configured so that it can be operated and maintained in a manner which, complies with the requirements of the Technical Rules, and is consistent with good electricity industry practice; and

   iii) otherwise satisfy the requirements of Connection Principle 1.

2.2.7 Principle 4

The configuration of the connection arrangement for a new *facility* (including any required *augmentation* or extension to the *transmission system*) must be designed in a manner which:

a. is compatible with the existing *transmission system*;

b. does not hinder the future development of the *transmission system* in accordance with Western Power's strategic vision – that is Transmission System Plan (TSP), Whole of System Plan (WOSP) or similar techno-economic studies, and *good electricity industry practice*; and,

c. does not hinder access by other *Users* to the *transmission system*.

2.2.8 Principle 4 - specific design requirements

a. Access to any new substation from the nearest public road must be unhindered and the relevant access road must be suitable for transportation of standard *transmission systems* primary and secondary plant.

b. The orientation and location of the proposed site for a new substation will be chosen within reason, to ensure that the proposed location will not indirectly hinder access (sterilisation) by other *Users* to Western Power's *transmission system*.

2.2.9 Principle 5

The configuration of the connection arrangement for a new *facility* must be designed in a manner which:

a. complies with clause 3.2.2 of the Technical Rules; and,

b. complies with the Metering Code with regards to Revenue Metering principles and location of the Revenue Meters.

2.2.10 Principle 5 - specific design requirements

a. For a new load connection, the *CMS* shall be owned by the *User*.

b. For a new generator connection, the ownership of *CMS* may vary based on the connection arrangement and the following requirements shall apply:

(i) the preference is for the *CMS* to be owned by the *User*. This will allow the *User* to be able to de-energise its own equipment without relying on Western Power; or,

(ii) the *CMS* may be owned by Western Power providing the requirements of Technical Rules 3.3.3.10 are adhered to including the requirement for a *meshed substation*. This means the *User* will have to rely on Western Power to de-energize their equipment and in some cases provide isolation for maintenance.

c. For a new storage system connection, the requirements will be the same as for a load and the *CMS* shall be owned by the User.

2.3 *Connection Assets* and Shared Assets

Assets that form part of a transmission connection, which are owned and operated by Western Power can be categorised as '*connection asset*' or 'shared asset' based on their function. Capital contributions will be devised according to the regulatory requirements of the Access Code and Western Power guidelines.

2.4 Substations and *Transmission Lines*

Western Power uses standard primary plant designs, equipment and systems that are applied to maintain and improve power system security, network reliability, reduce long term costs and support *good electricity industry practice*. Where Western Power is to own the assets at any stage in the future, its standards shall be complied with where the assets are built by the *User*.

Western Power currently utilises two standard transmission substation configurations which are:

1. Single Busbar.
2. Breaker and a Half.

There are existing substations with busbar configurations that are not included in this document as they are not supported options for future greenfield substations.

Where a new Western Power substation is required for a transmission connection, the *User* must facilitate Western Power's acquisition of the required land and all necessary approvals for the substation and connecting *transmission lines*, regardless of who owns the *transmission line*. When selecting the substation configuration for the new connection, Western Power will consider the connection arrangements illustrated in section 3.

2.5 Protection, Control & Communications

Western Power uses standard protection, control, and communication equipment that are applied to maintain and improve power system security, network reliability, reduce long term costs and support *good electricity industry practice*.

Connection applicants shall consult with Western Power concerning design and equipment selection for all protection functions, which are required to coordinate and grade with the *transmission system* to:

a. minimise interruption or restrictions to transmission services due to the operation of those protection functions; and

b. ensure compatibility with the *transmission system*.

Western Power will provide the *User* with a Customer Connection Design Requirements document to outline the required interfaces between the *User* and Western Power equipment.

Where Western Power owns the connecting *transmission line*, the *User* shall provide Western Power with a suitable building or room to house the required protection, control, auxiliaries, metering, and communication equipment at the *User's* substation. It is mandatory that Western Power personnel are provided with 24/7 unimpeded access to the room or building which houses the protection, control, and communication equipment. Failure to provide appropriate access may result in delays to fault recovery and extended outage periods.

Where the *User* owns the *transmission line* and they require primary plant outside of Western Power's substation, the *User* shall provide their own building to house the required protection, control, auxiliary and communication equipment. The *User's substation* shall be immediately adjacent to Western Power's to facilitate the inter-substation protection that will be required.

2.6 Tariff/Revenue Metering

The revenue/tariff metering requirements and the location of the meters shall comply to the Electricity Industry Metering Code 2012.

3. Connection Arrangements for New *Facilities*

3.1 Overview of Connection Arrangements

This section sets out several connection arrangements for a new *facility* connecting to Western Power's *transmission system*. These are high-level single line diagrams which are intended to show the basic plant, equipment and switching configuration that will be required to accommodate the new connection. They also ensure consistency with the principles outlined in this document. Note that not all secondary assets are included in these diagrams. The solutions matrix in summarises the connection options outlined in sections Table 5 and 3.3.

The following factors shall be considered by the *User* and Western Power when developing options for a connection to Western Power's *transmission system*:

a. the Connection Principles set out in Section 2.2;

b. maximum allowable capacity of the connection arrangement as shown in Table 4. These limiting values may need to be adjusted down in situation where Western Power circuits and equipment are not adequately rated or the power system performance in the area does not satisfy Technical Rules or Market Rules requirements with the new connection in service;

c. operational flexibility of the connecting demand or generation to maximise asset utilisation;

d. *User* reliability & availability requirements of the connection;

e. supply arrangements during planned and unplanned outages on the connection circuit and Western Power network;

f. electricity market impacts for credible contingencies;

g. alignment with Western Power's long term network strategy;

h. overall life cycle costs of the connection arrangement including the costs associated with reliability impacts, maintenance, losses, outage constraints and any relevant mitigations required such as market costs or temporary protection modifications etc.; and,

i. for generator connections via a customer owned line, the GPS assessment needs to account for losses along the line up to the *connection point.*

Connection applicants for a new *facility* may choose to negotiate connection arrangements that are more secure and reliable than the minimum arrangements shown below in 3.2 and 3.3.

The configurations and division of assets must comply with the Technical Rules unless otherwise agreed between Western Power and the *User*.

Table 4

	Generator	Load	Storage
Single Busbar substation	The maximum aggregate generation on a single section of busbar is nominally 150 MW subject to an operational acceptability assessment.	The maximum aggregate load on a busbar that would be taken out of service during a busbar contingency is 90 MVA.	The aggregate load (including BESS charging) on a busbar that would be taken out of service during a busbar contingency is up to a nominal value 150 MVA, subject to an operational acceptability assessment. BESS discharging is the same as for a generator.
Breaker and a Half substation	The maximum generation able to be connected using this arrangement is such that the *loss of power infeed* connected to any single circuit under the contingencies outlined in Section 2.2.3 shall not exceed the *infeed loss risk limit.*	The maximum capacity of a load system permitted to connect via any single circuit shall be 250 MVA.	BESS charging requirements are as for a load. BESS discharging requirements are as for a generator.

Table 5

<table>
<tr><th rowspan="3">Connection Arrangement</th><th rowspan="3">Voltage Level</th><th colspan="2" rowspan="2">Connecting Transmission Line</th><th colspan="2" rowspan="2">Generator Size (Including BESS)</th><th colspan="2">Aggregate Load Size</th></tr>
<tr><th>≤ 90 MVA</th><th>> 90 MVA</th></tr>
<tr><th colspan="2">Including BESS</th></tr>
<tr><th>Ownership</th><th>Length</th><th>≤ 150 MW†</th><th>> 150 MW†</th><th>≤ 150 MVA†</th><th>> 150 MVA†</th></tr>
<tr><td rowspan="2">Connection to existing zone substation or single busbar substation</td><td rowspan="2">≤ 132 kV</td><td>Western Power</td><td rowspan="2">Any</td><td>Figure 1</td><td rowspan="2">Not Permitted</td><td>Figure 1</td><td rowspan="2">Not Permitted</td></tr>
<tr><td>User</td><td>Figure 2</td><td>Figure 2</td></tr>
<tr><td rowspan="2">Connection to existing terminal station</td><td rowspan="2">≥ 132 kV</td><td>Western Power</td><td rowspan="2">Any</td><td colspan="3">Figure 3*</td></tr>
<tr><td>User</td><td colspan="2">Figure 4*
Figure 5*</td><td>Figure 5*</td></tr>
<tr><td rowspan="2">Cut-in / cut-out of existing line (via new terminal station)</td><td rowspan="2">≥ 132 kV</td><td>Western Power</td><td rowspan="2">Any¥</td><td colspan="3">Figure 6*</td></tr>
<tr><td>User</td><td colspan="2">Figure 7*
Figure 8*</td><td>Figure 8*</td></tr>
<tr><td rowspan="2">Cut-in / cut-out of existing line (via new single busbar substation)</td><td rowspan="3">≤ 132 kV</td><td>Western Power</td><td rowspan="2">Any¥</td><td>Figure 9</td><td rowspan="3">Not Permitted</td><td>Figure 9</td><td rowspan="3">Not Permitted</td></tr>
<tr><td>User</td><td>Figure 10
Figure 11</td><td>Figure 11</td></tr>
<tr><td>Tee connection to customer facility</td><td>Western Power</td><td>≤ 5 km or 10%</td><td>Figure 12</td><td>Figure 12</td></tr>
</table>

* See Table 4. For additional capacity, further circuits would be required.
¥ While the length of line past the *CMS* is decided by the *User*, the new substation shall be within 2.5 km of the existing line.
†Nominal value only – subject to operational acceptability assessment

3.2 Connection to a Western Power substation

Connection to an existing Western Power substation is often the most efficient choice for *Users* seeking to connect a new *facility* in the vicinity of an existing Western Power substation. The following diagrams show connection arrangements for a transmission connection to an existing Western Power substation and indicate the *connection point*, metering point, *connection assets* and asset ownership.

3.2.1 Connection of a generator, load or storage system to an existing *zone substation* - single busbar configuration – Western Power owned *transmission line*

This arrangement may be suitable for transmission *Users* who seek to connect to an existing Western Power non-meshed substation via a *transmission line* owned by Western Power.

This is also applicable where the *User's facility* is adjacent to a suitable Western Power zone substation. Note that the Western Power circuit breaker will still be required as the extension of the existing bus zone protection is not an acceptable solution.

See Table 5 for details of applicability.

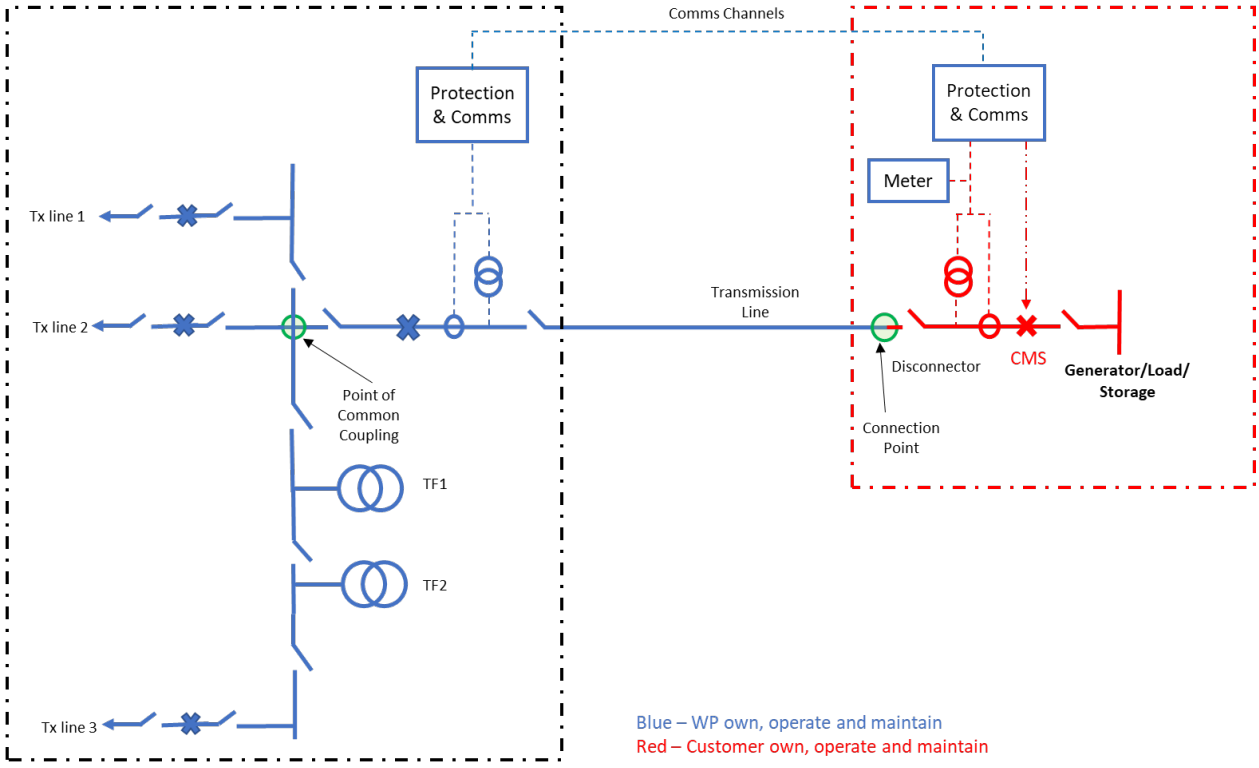

Figure 1 - Connection of generator, load or storage system to an existing *zone substation* - single busbar configuration– Western Power owned connecting *transmission line*

3.2.2 Connection of generator, load or storage system to an existing *zone substation* - single busbar configuration– *User* owned *transmission line*

This arrangement may be suitable for transmission *Users* who seek to connect to an existing Western Power non-meshed substation via a direct *transmission line* owned by them.

This arrangement will enable the *User* to own, operate, and maintain the protection, control and communication systems of the *transmission line* including the primary plant (CT, VT & disconnector/earth switch). This option will be constrained by the availability of land adjacent to Western Power's site for the *User* to accommodate the additional CB, CT, VT & disconnector/earth switch, and secondary equipment. Therefore, it may not be a feasible option in all cases.

See Table 5 for details of applicability.

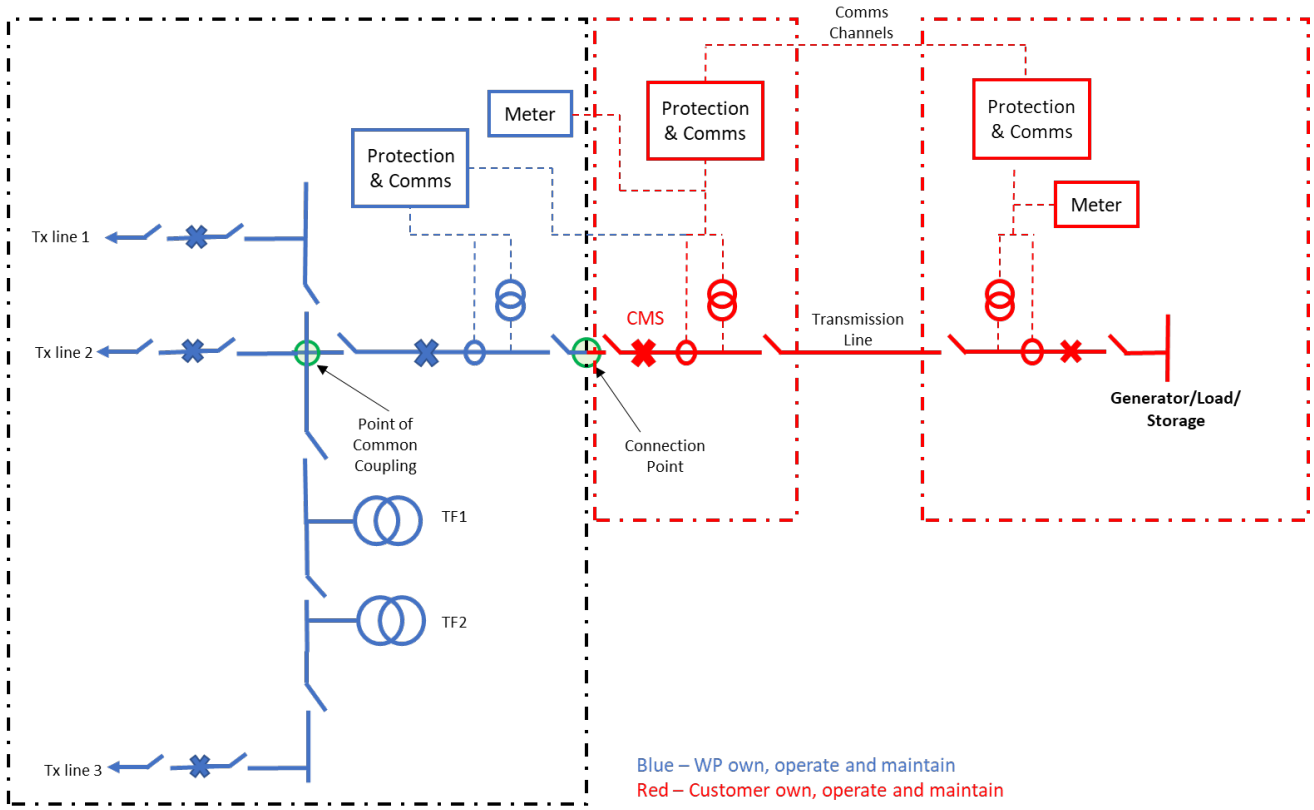

Figure 2 - Connection of a generator, load or storage system to an existing *zone substation* - single busbar configuration– *User* owned connecting *transmission line*

3.2.3 Connection of a generator, load or storage system to an existing *terminal station* - Western Power owned *transmission line*

This arrangement may be suitable for transmission *Users* who seek to connect to an existing Western Power breaker and a half configuration via a *transmission line* owned by Western Power. See Table 5 for details of applicability.

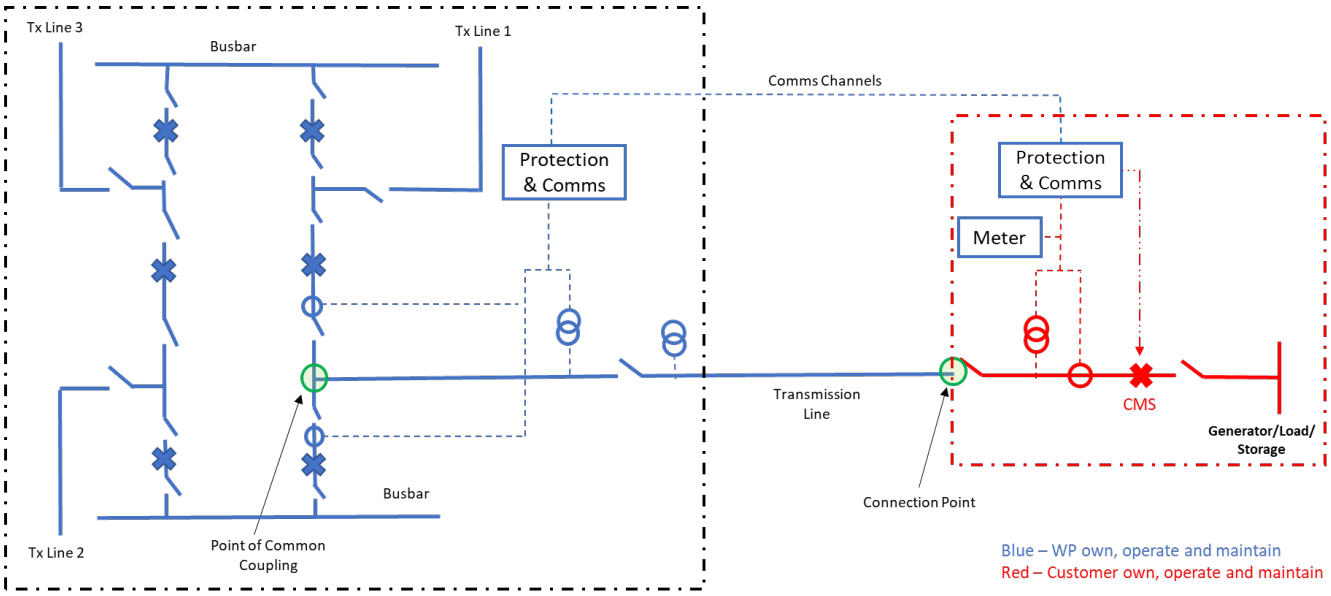

Figure 3 - Connection of generator, load or storage system to an existing *terminal station* - breaker and a half configuration –Western Power owned *transmission line*

3.2.4 Connection of a generator, load or storage system to an existing *terminal station - Customer* owned *transmission line*

These connection arrangements may be suitable for transmission *Users* seeking to connect to an existing Western Power *terminal station* breaker and a half configuration via a direct *transmission line* owned by the *Customer*.

- Generator *Users* have the option to select from arrangements shown in Figure 4 or Figure 5 depending on the level of flexibility required when de-energizing their own equipment.
- Load and storage system *Users* shall utilise the arrangement shown in Figure 5 when connecting to an existing Western Power *terminal station*.
- Figure 5 (and to a lesser extent Figure 4) may not be practicable for brownfield sites due to limitations of land availability adjacent to Western Power's substation. In this case it may not be feasible for the *User* to own the *transmission line*.

See Table 5 for details of applicability.

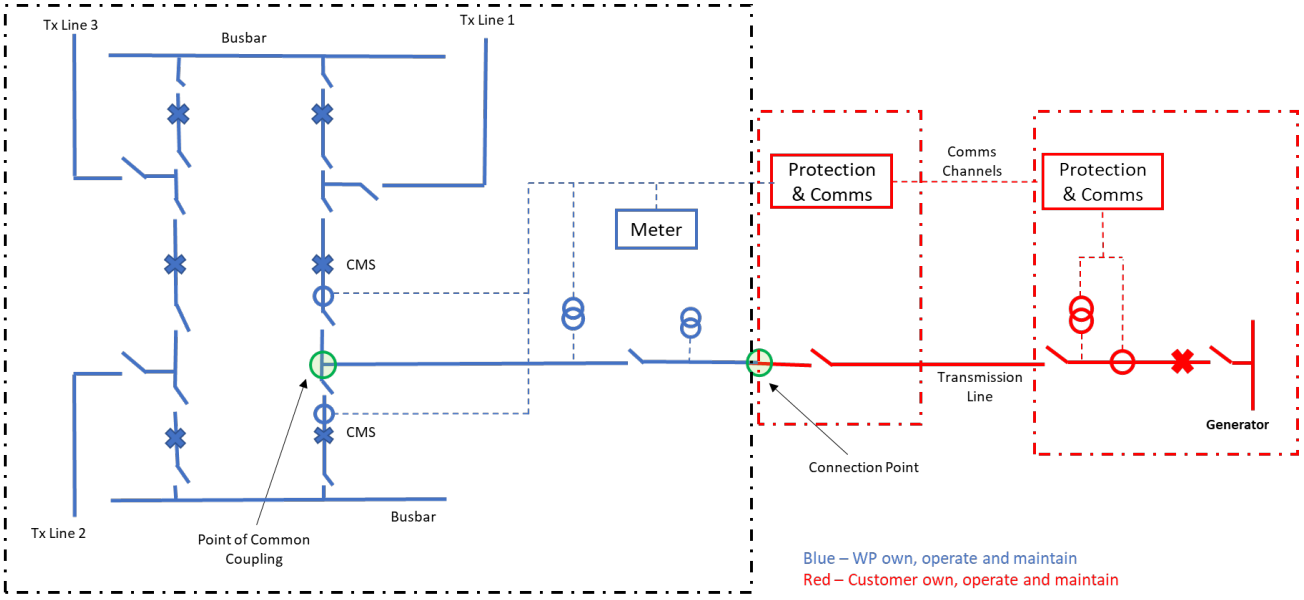

Figure 4 - Connection of generator to an existing *terminal station* - breaker and a half configuration – User owned *transmission line*

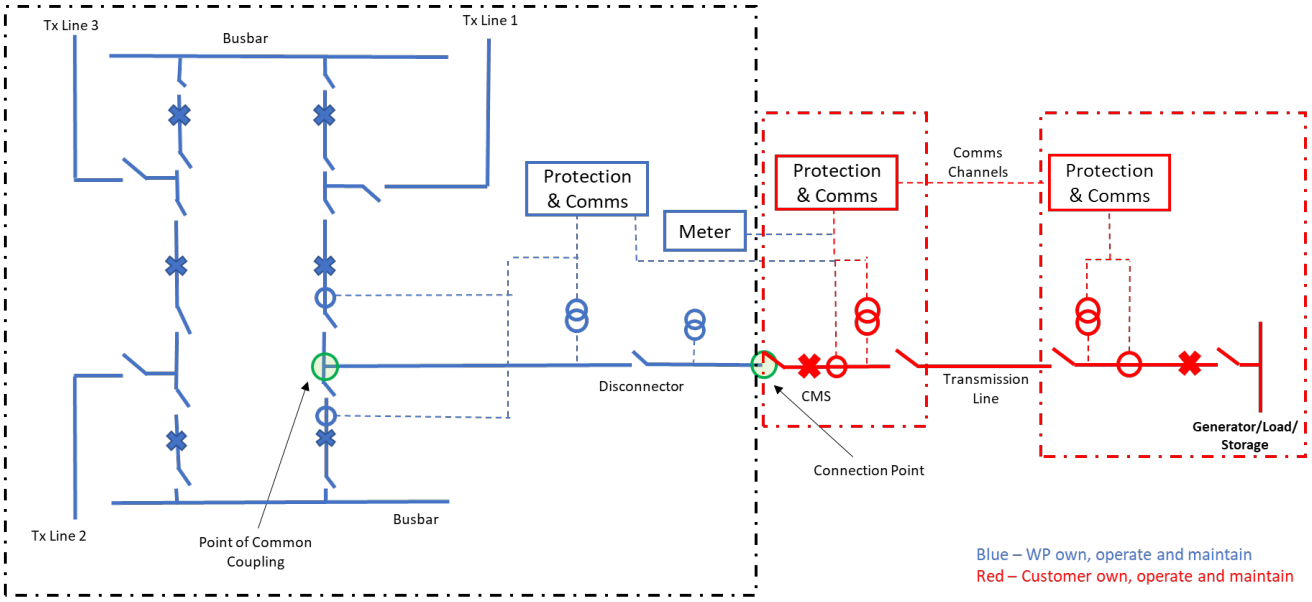

Figure 5 - Connection of generator, load or storage system to an existing *terminal station* - breaker and a half configuration – User owned *transmission line*

3.3 Connection to a Western Power *Transmission Circuit*

Where *Users* seek to connect a *facility* and are not in the vicinity of a suitable Western Power substation, a connection to nearby *transmission circuits* should be considered. In this case a new Western Power owned substation will be required to provide connection to the *User's facility*.

The following diagrams show a range of connection arrangements and indicate the *connection point*, metering point, *connection assets*, and asset ownership.

3.3.1 Cut in cut out via a new *terminal station* for a generator, load or storage connection to a Western Power owned *transmission line*

This connection arrangement may be suitable for transmission *Users* who seek to connect to an existing Western Power *transmission circuit* via a cut in cut out breaker and a half substation which connects to the *Customer facility* via a *transmission line* owned by Western Power.

a. For capacity greater than the values shown in Table 4, additional circuit connections will be required to both the cut in cut out substation and to the *User*'s *facility*.

b. The maximum distance from the existing *transmission line* to the cut in cut out substation is 2.5 km.

See Table 5 for details of applicability. for details of applicability.

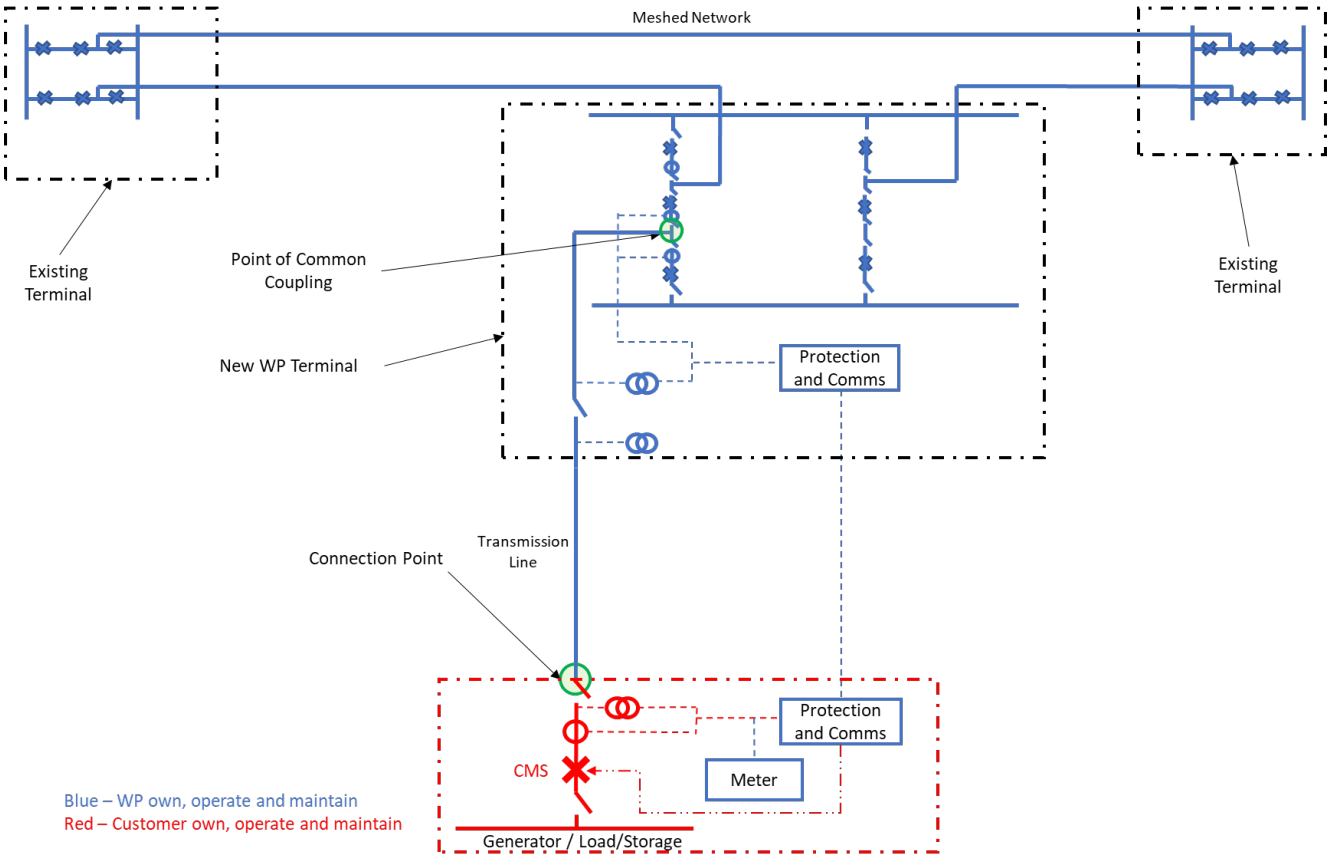

Figure 6 – Cut in cut out connection arrangement to existing Western Power *transmission circuit* for a generator, load or storage system – Connection to a User's *facility* via a Western Power owned *transmission line*

3.3.2 Cut in cut out via a new *terminal station* for a generator, load or storage connection to a *User* owned *transmission line*

These connection arrangements may be suitable for transmission *Users* who seek to connect to an existing Western Power *transmission circuit* via a cut in cut out breaker and a half substation where the *User* owns the line to their *facility*.

a. Generator *Users* have the option to select from arrangements shown in Figure 7 or Figure 8 depending on the level of flexibility required when de-energizing their own equipment.

b. Load or storage system *Users* shall utilise the arrangement shown in Figure 8 when connecting to a new Western Power *terminal station*.

c. For capacity greater than the values shown in Table 4, additional circuit connections will be required to both the cut-in-cut-out substation and to the *User*'s *facility*.

d. The maximum distance from the existing *transmission line* to the cut in cut out substation is 2.5 km.

See Table 5 for details of applicability. for details of applicability.

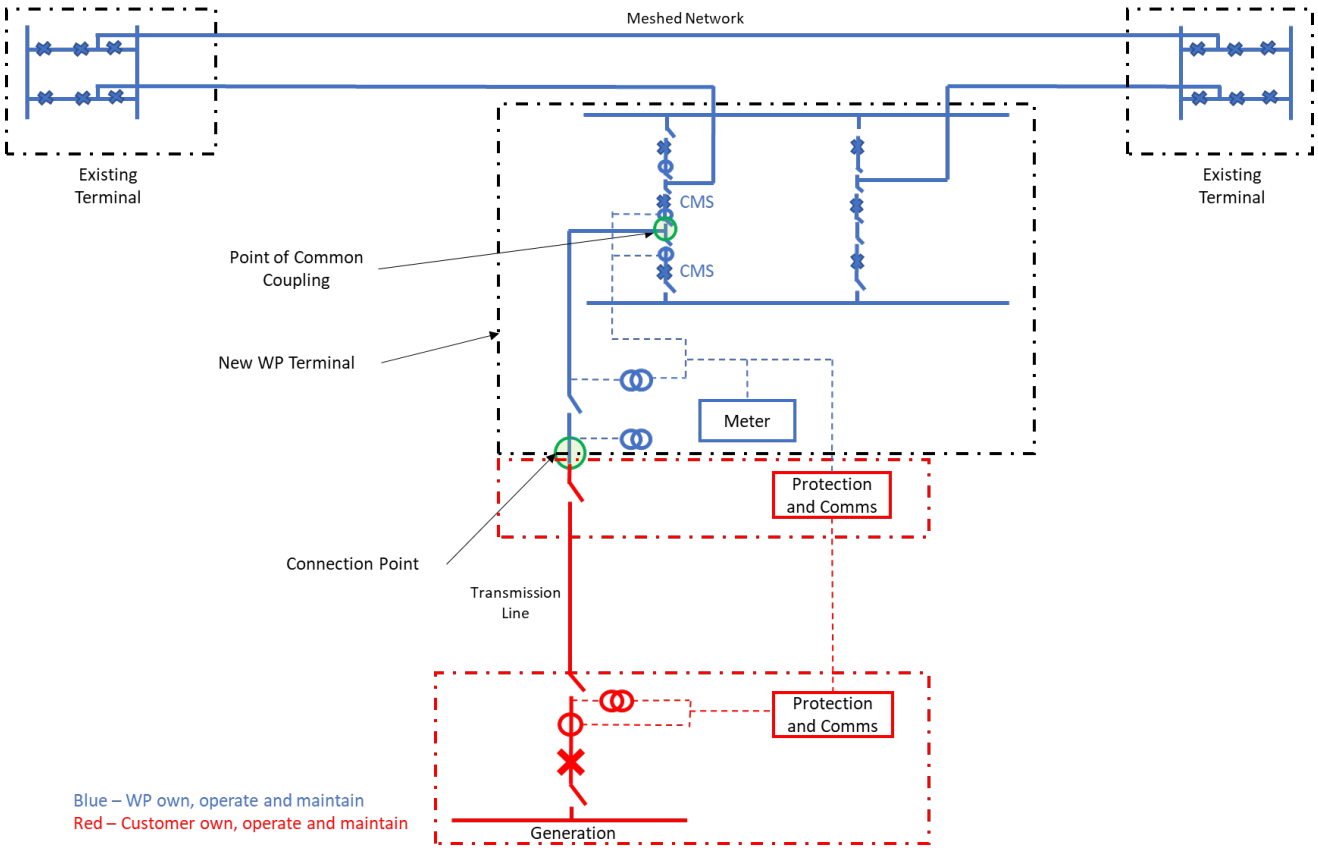

Figure 7 - Cut in cut out connection arrangement to existing Western Power *transmission circuit* for a Generator connection via a User owned *transmission line* and Western Power owned *CMS*

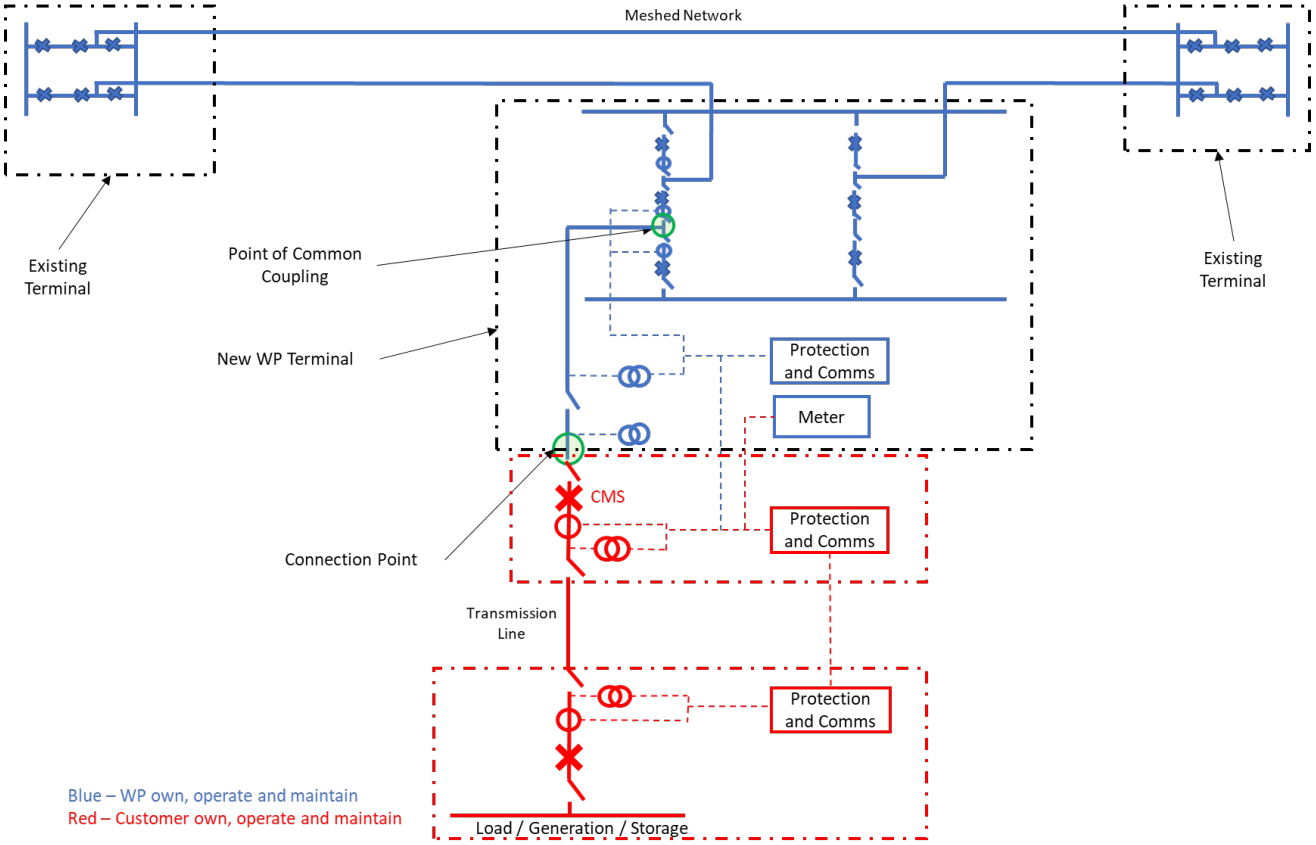

Figure 8 - Cut in cut out connection arrangement to existing Western Power *transmission circuit* for a generator, load or storage system. Connection to User *facility* via a User owned *transmission line* and User owned *CMS*

3.3.3 Cut in cut out connection via a *switchable busbar* substation for a generator, load or storage connection to a Western Power owned *transmission line*

This connection arrangement may be suitable when a transmission *User* seeks to connect to an existing Western Power *transmission circuit* via a cut in cut out connection at 132kV or below, where Western Power is to own the connecting *transmission line*.

The maximum distance from the existing *transmission circuit* to the cut in cut out substation is 2.5 km.

See Table 5 for details of applicability. for details of applicability.

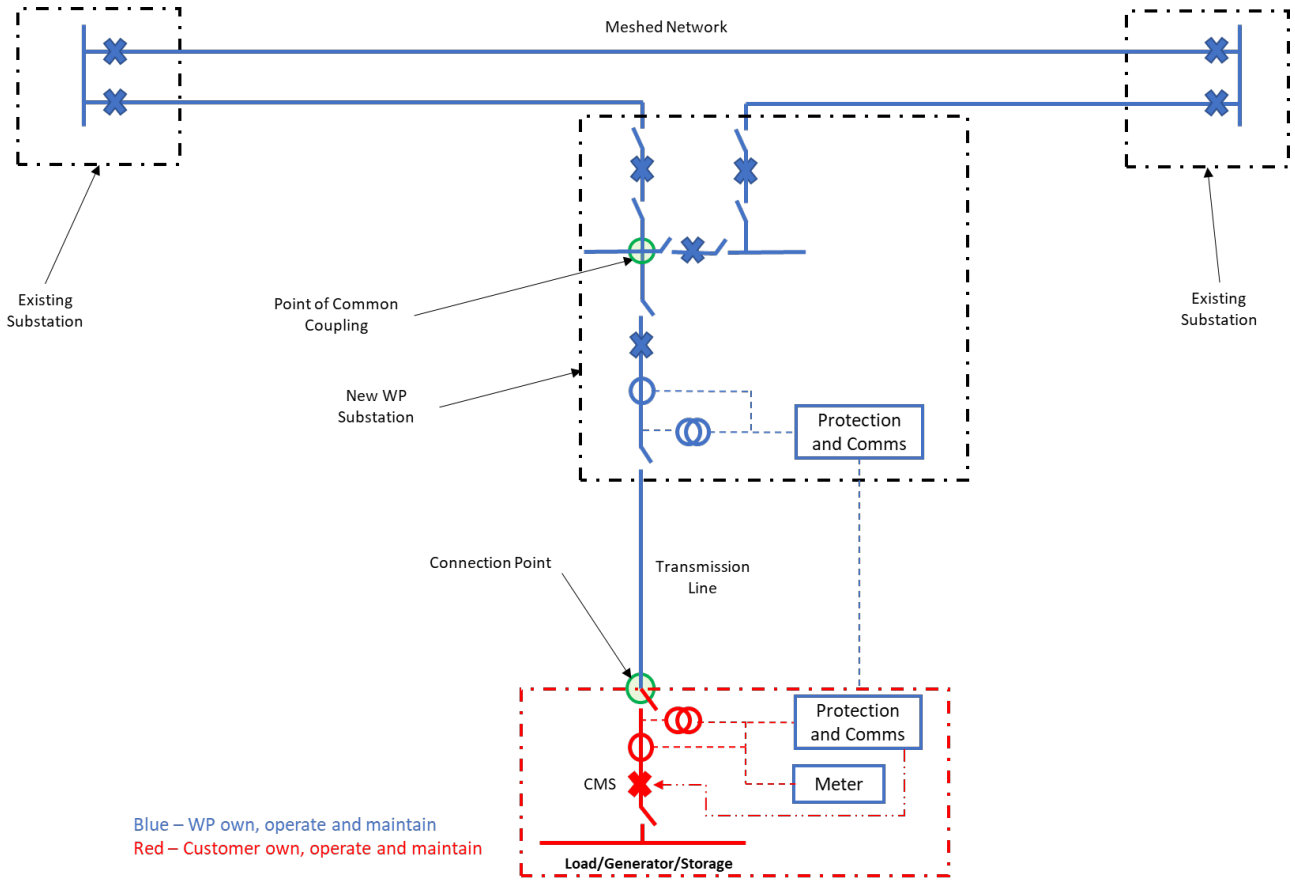

Figure 9 - Cut in cut out connection arrangement to existing Western Power *transmission circuit* via a switchable busbar. Connecting *transmission line* is owned by Western Power

3.3.4 Cut in cut out via a *switchable busbar* substation for a generator, load or storage connection to a *User* owned *transmission line*

This connection arrangement may be suitable when a transmission *User* seeks to connect to an existing Western Power *transmission circuit* via a cut in cut out connection at 132kV or below where the *Customer* is to own the connecting *transmission line*.

a. Generator *Users* have the option to select from arrangements shown in Figure 10 or 11 depending on the level of flexibility required when de-energizing their own equipment.

b. Load and storage system *Users* shall utilise the arrangement shown in Figure 11 when connecting to this type of substation.

c. The maximum distance from the existing *transmission line* to the cut in cut out substation is 2.5 km.

See Table 5 for details of applicability.

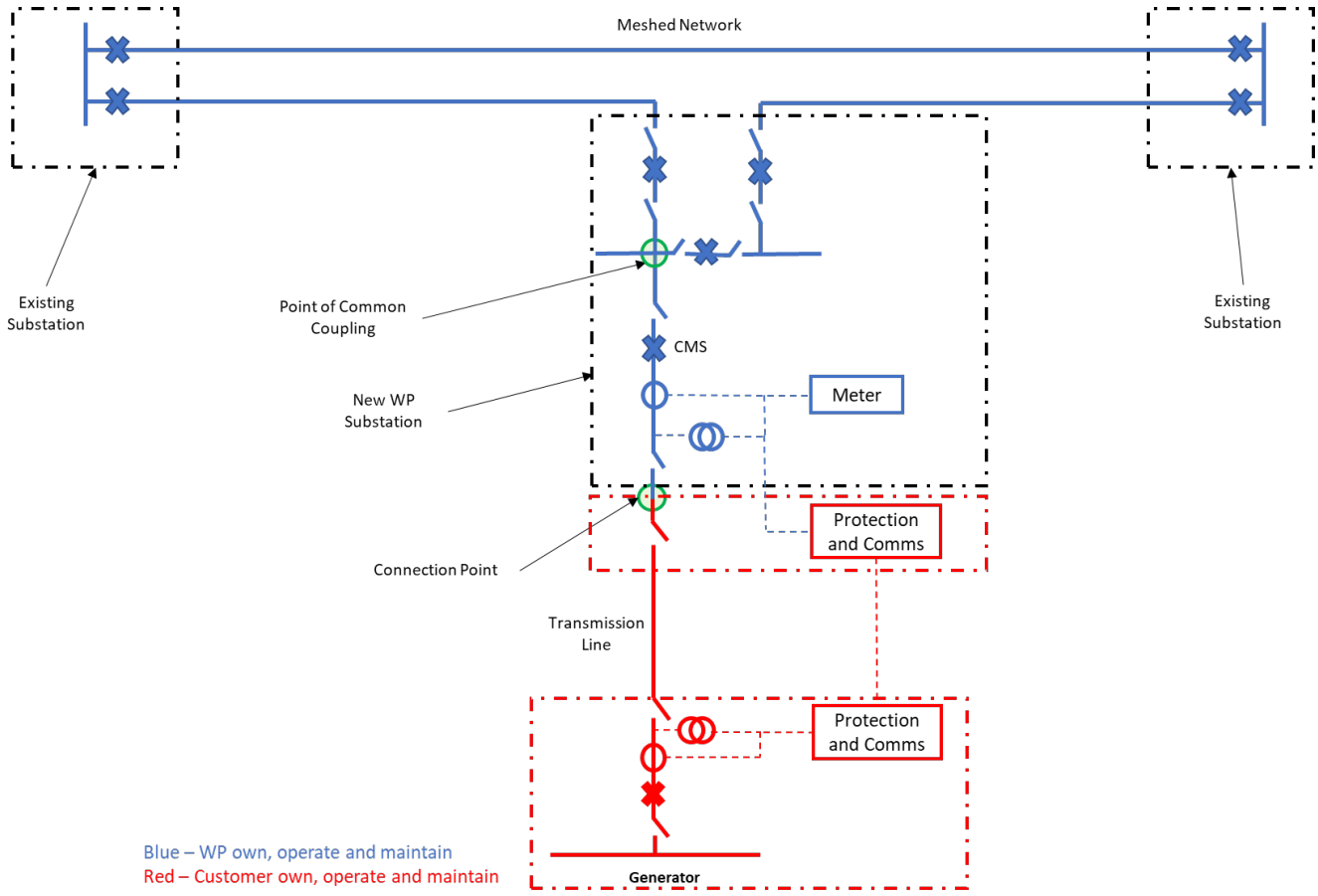

Figure 10 - Cut in cut out connection arrangement (generator connection) to existing Western *Power transmission circuit* via a switchable busbar. Connection to *a generator* via a *Customer* owned *transmission line* and Western Power owned *CMS*

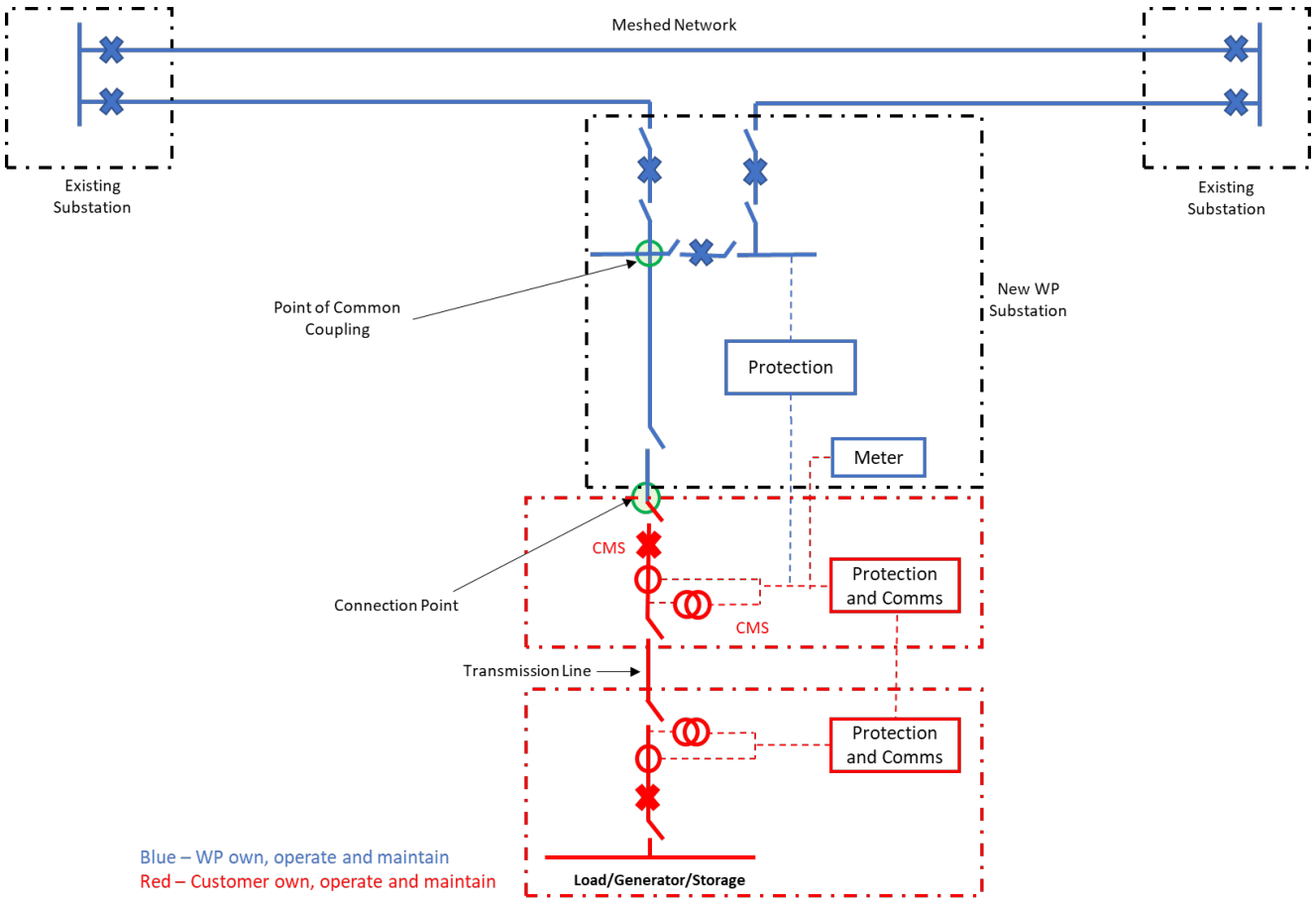

Figure 11 - Cut in cut out connection arrangement for a generator, load or storage system to existing Western Power *transmission circuit* via a *switchable busbar*. Connection to *Customer facility* via a *Customer* owned *transmission line* and *Customer* owned *CMS*

3.3.5 Tee connection from an existing Western Power owned *transmission circuit* – short Tee line owned by Western Power

This connection arrangement may be suitable when a transmission *User* seeks to connect to an existing Western Power *transmission circuit* at ≤ 132kV via a short Tee connecting line.

a. The maximum length of the Tee connection line from existing *transmission line* is 10% of the line being teed into, or 5 km (whichever is less).

b. This configuration is also applicable to a radial (non-meshed) network, providing Principle 1 is adhered to.

See Table 5 for details of applicability. for details of applicability.

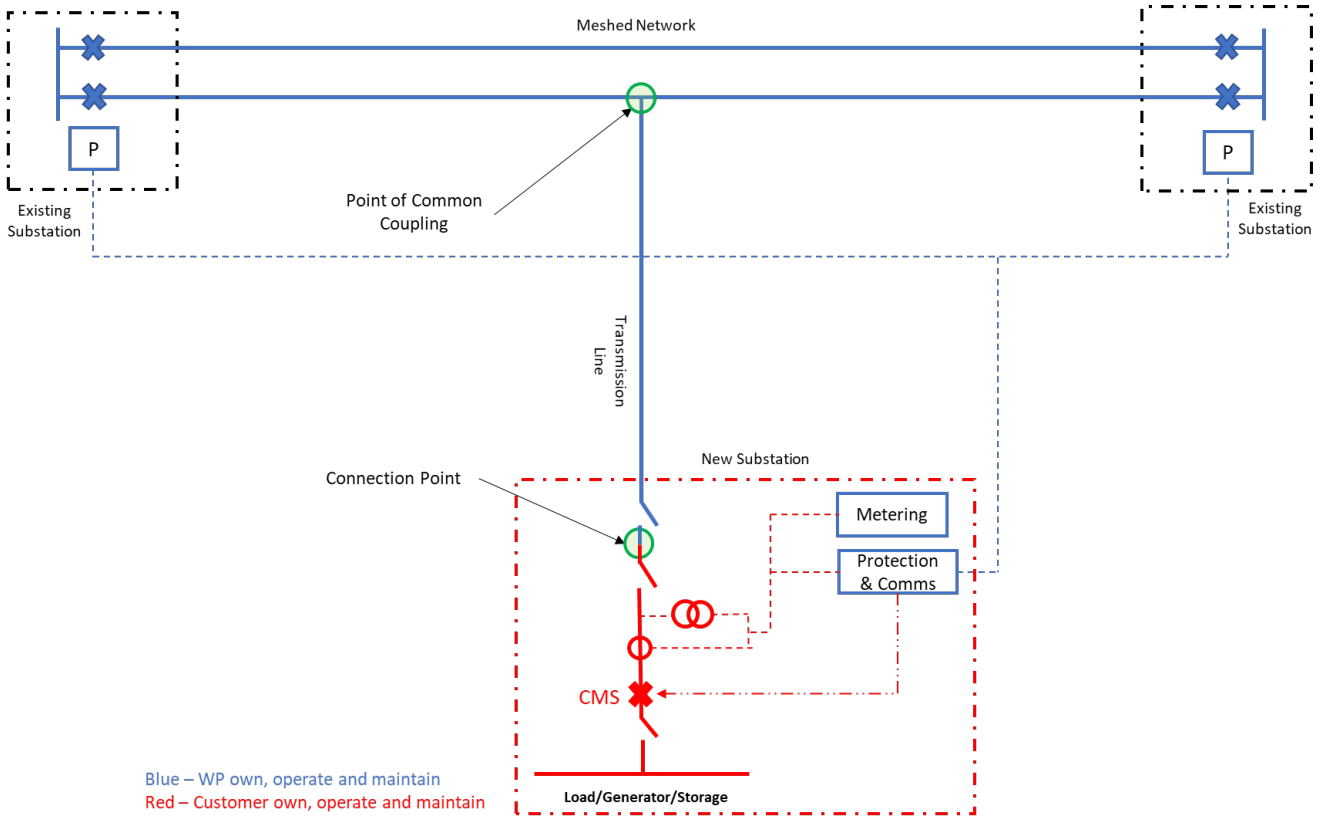

Figure 12 - Tee connection to an existing Western Power owned *transmission circuit* for a Generator or Load – Short Tee line owned by Western Power