

Company Directive

STANDARD TECHNIQUE: SD4OB

11kV and 6.6kV Connections to Customers and IDNOs Primary Switchgear Arrangements

Policy Summary

This document specifies the requirements for 11kV and 6.6kV (High Voltage) connections to Customers and IDNOs using **Primary Switchgear**

Author: Andy Hood

Implementation Date: April 2019

Approved by



Policy Manager

Date:

16 April 2019

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IMPLEMENTATION PLAN

Introduction

This document, ST: SD4OB specifies the requirements for 11kV and 6.6kV (High Voltage) connections to customers and IDNOs using **Primary Switchgear**.

Main Changes

A link has been provided to WPD's generic civil drawings. These drawings are accessible to WPD staff and to ICPs. Also the document number has changed.

Impact of Changes

This change provides WPD staff with access to WPD's generic civil drawings. The document is relevant to all staff and ICPs involved in the design, installation, maintenance and replacement of these connections.

Implementation Actions

Managers shall ensure all relevant staff and contractors are made aware of and follow the requirements of this document.

Implementation Timetable

This policy shall be implemented on issue for new and substantially modified customer and IDNO connections.

REVISION HISTORY

Document Revision & Review Table		
Date	Comments	Author
April 2019	<ul style="list-style-type: none"> The document number has changed from ST: SD4O Part 2 to ST: SD4OB Clause 5.0 – A link to WPD's generic civil drawings has been added 	Andy Hood
October 2018	<p>ST: SD4O has been completely re-written and split into two documents, ST: SD4O Part 1 and part 2. This document (Part 2) includes the following significant changes:</p> <ul style="list-style-type: none"> Requirements for Secondary Switchgear arrangements (Arrangement 1 to 3) have been removed Requirements for IDNO connections have been added The following arrangements for radial networks have been added: <ul style="list-style-type: none"> Arrangement 4 Arrangement 5A and 5B Arrangement 6A, 6B and 6C The following arrangements for parallel networks have either been added or modified: <ul style="list-style-type: none"> Arrangement 7A and 7B Arrangement 8A, 8B and 8C The following primary substation arrangements have been added: <ul style="list-style-type: none"> Arrangement 9A and 9B Arrangement 10A and 10B Requirements for switchgear accommodation section have been modified (Section 5.0) Guidance on complex metering arrangements has been added (Clause 9.3) Requirements for LV AC supplies has been added (Section 11) Requirements for generator connections has been modified (Section 14) Requirements for multiple connections have been modified (Section 15) 	Andy Hood

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1.0 INTRODUCTION

ST: SD4OB specifies the requirements for 11kV and 6.6kV (high Voltage) connections to customers and IDNOs using **Primary Switchgear**. It should be read in conjunction with ST: SD4A (HV Network Design) and ST: SD4OA (11kV and 6.6kV Connections to Customers and IDNOs using **Secondary Switchgear**).

Western Power Distribution restrict the use of Distribution Switchgear to relatively simple connections rated up to 400A per circuit breaker whereas **Primary Switchgear** may be used for loads up to 630A per circuit breaker. **Primary Switchgear** may also accommodate more complex protection systems (e.g. directional protection, unit protection and partial differential busbar protection) and therefore may be used to provide protection within parallel WPD networks.

Where any difficulty is encountered in applying this document the author shall be notified who will determine if a variation is appropriate.

2.0 DEFINITIONS

Connection Point: The point at which a customer, DNO or IDNO connects to WPDs distribution system.

Secondary Switchgear: Switchgear within the scope of EE SPEC: 2. This normally consists of non-extensible ring main units, and fuse switch equivalent circuit breakers, however a range of extensible **Secondary Switchgear** is also available.

Primary Switchgear: Indoor 12kV switchgear / switchboards within the scope of EE SPEC. This type of switchgear is the type typically used within primary substations.

Connection Control Panel (CCP): A panel that is used to actively manage the load (imported or exported) at the **Connection Point**. This panel may, for example, include voltage constraint, soft intertrip and/or active network management facilities.

This document makes reference to both customers and Independent Network Operators (IDNOs). A customer has the same meaning as a consumer, as defined in the [Electricity Safety, Quality and Continuity Regulations 2002](#) (ESQCRs). An IDNO is not a customer but rather a type of Distribution Network Operator.

3.0 STANDARD ARRANGEMENTS

3.1 General

Primary Switchgear arrangements are spilt into three basic types, those connected to radial High Voltage (HV) circuits, those connected to parallel HV circuits and those connected at primary substations. There are also subtle differences between customer connections and connections to IDNO networks.

The following sections include single line diagrams that show the basic switchgear layout and protection functions. A key to these diagrams is provided in Appendix A. Each diagram also includes a specification reference which ties up with the references in the associated switchgear and protection panel specifications.

3.2 Arrangements Connected to WPD owned Radial Circuits

The majority of WPD's HV network is based on a series of radial circuits that are interconnected with each other via normally open switches (e.g. ring main units or air break isolators). Where the network is radial HV customer connections and IDNO connections are normally connected using **Secondary Switchgear** (e.g. ring main units and secondary circuit breakers). These arrangements are detailed in ST: SD4OA.

Primary Switchgear has additional CT and VT and protection accommodation, is fitted with full tele-control facilities and is used where higher import/export capacities (up to 630A per metering circuit breaker) are required and where more complex arrangements are needed.

Arrangement 4 is designed for teed connections whereas Arrangement 5 and 6, each of which have a number of variations, are suitable for ringed connections. Figure 1 summarises a number of these arrangements.

A key to the single line diagrams is given in Appendix A

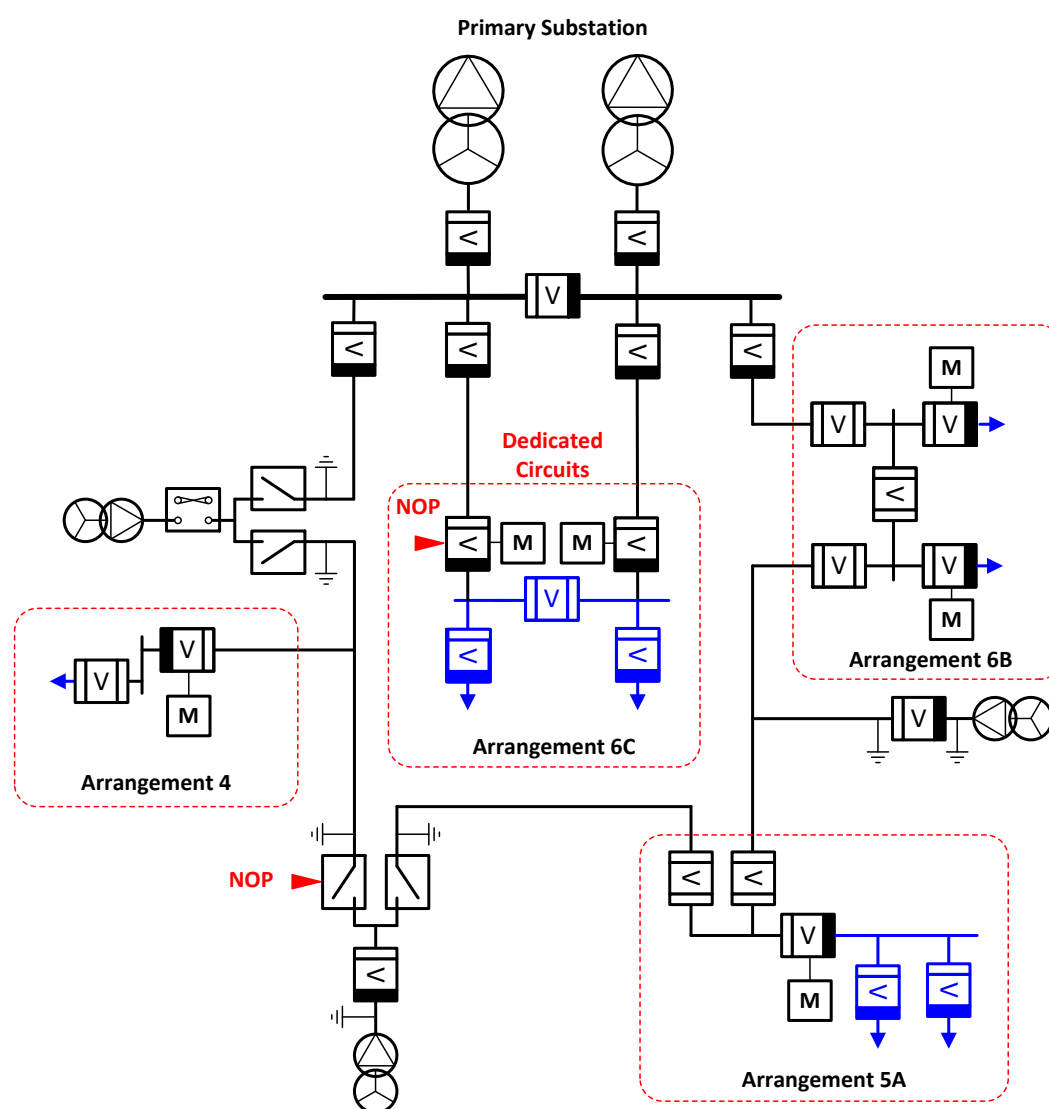


Figure 1 Example of Arrangement 4, 5 and 6 installed within a Radial Network

3.2.1 Arrangement 4

This option could theoretically consist of a single WPD owned 630A interface circuit breaker with cable termination facilities on both sides. In practice, however, two WPD panels are installed in order to provide the required cable termination and circuit earthing facilities, as shown in Figure 2.

Neutral voltage displacement protection is available, as standard. This function is disabled if it is not needed.

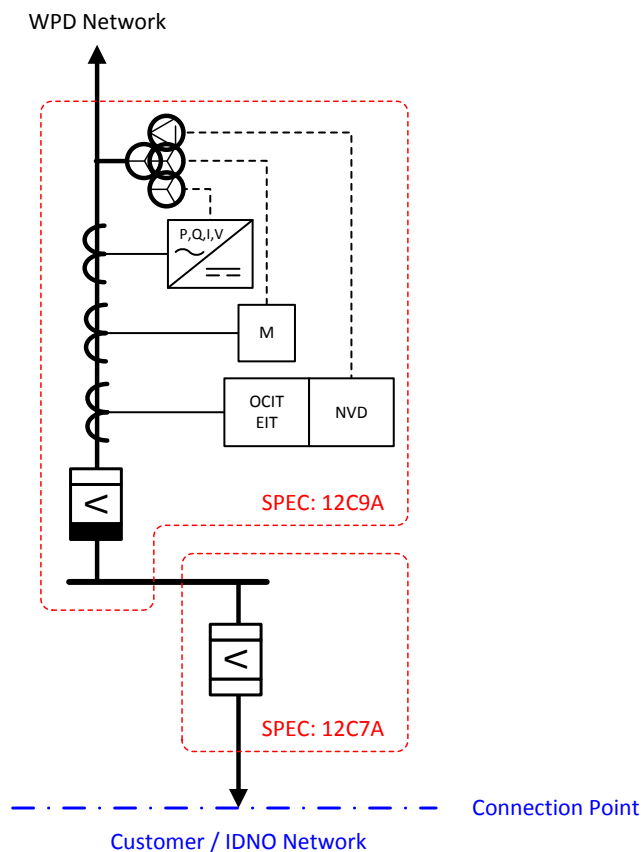


Figure 2 Arrangement 4

Notes:

- HV Metering panels are only provided at HV customer connections
- The maximum distance between the **Connection Point** and customer circuit breaker/s is 100m. This does not apply to IDNO connections.

3.2.2 Arrangement 5

The basic arrangement consists of a switchboard with two WPD incoming 630A circuit breakers. Interface circuit breakers are connected to one side of the incoming circuit breakers.

The incoming circuit breakers do not include directional relays or unit protection relays and so cannot be used to protect a parallel WPD network.

Two options, 5A and 5B, are available:

(a) Arrangement 5A

This arrangement consists of a shared switchboard that includes a WPD owned bus-section interface circuit breaker fitted on one side. Customer or IDNO outgoing circuit breakers are fitted at one end.

WPD's bus-section interface circuit breaker includes a metering VT and CTs but a HV metering panel is only installed at customer connections.

Neutral voltage displacement protection cannot be provided by WPD and so if this is required (i.e. where the Agreed Export Capacity is $\geq 500\text{kW}$) it must be provided by the customer on their HV switchgear.

(b) Arrangement 5B

This arrangement consists of a WPD owned switchboard that includes one or more outgoing interface circuit breakers fitted on one side of the incomers.

WPD's interface circuit breakers each include a metering VT and CTs but HV metering panels are only installed at customer connections.

Neutral voltage displacement (NVD) protection is provided by WPD as standard. Where NVD is not required this function is disabled within the protection relay settings.

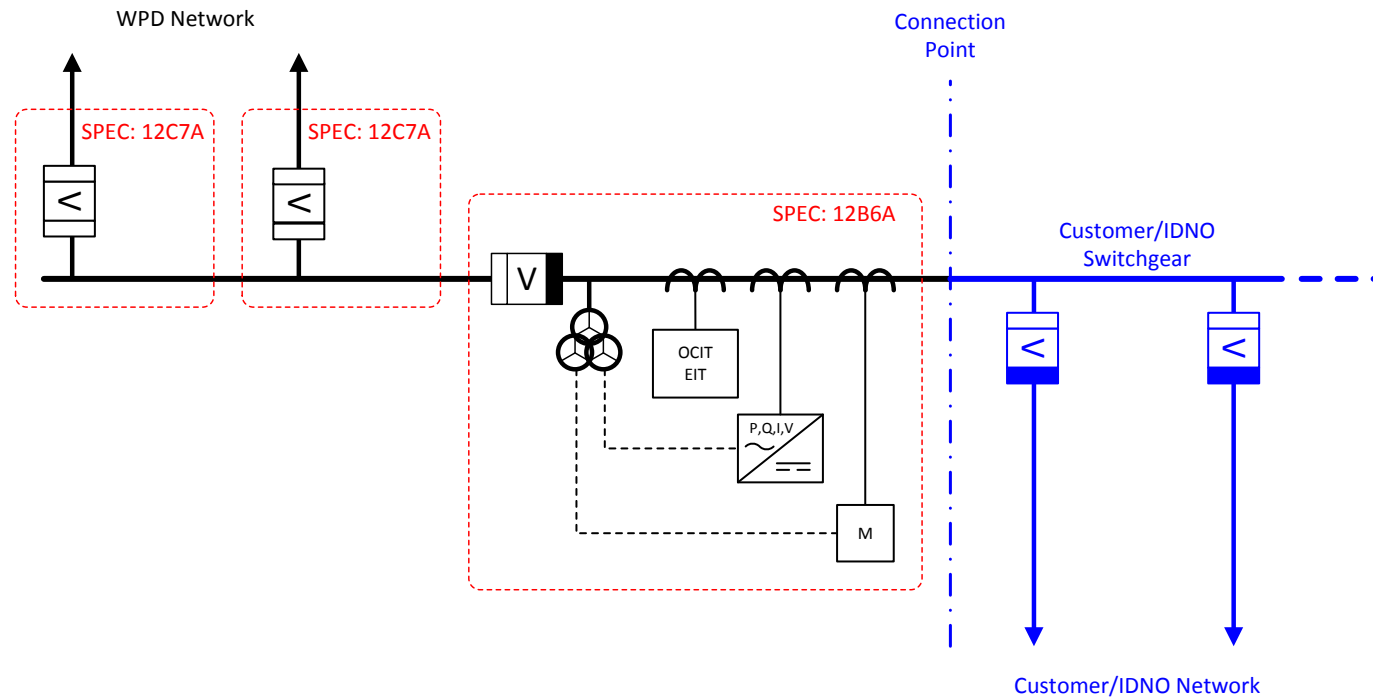


Figure 3 Arrangement 5A

Notes:

- *HV Metering panels are only provided at HV customer connections*
- *The maximum distance between the **Connection Point** and customer circuit breaker/s is 100m. This does not apply to IDNO connections.*

3.2.3 Arrangement 6

The basic arrangement consists of a switchboard with two WPD owned incoming 630A circuit breakers separated by a bus-section circuit breaker. Interface circuit breakers, also limited to 630A, are connected to either side of the incoming circuit breakers.

The incoming circuit breakers do not include directional relays or unit protection relays and so cannot be used to protect a parallel WPD network.

Three variants are available:

(a) Arrangement 6A

This arrangement consists of a shared switchboard that includes two WPD owned bus-section interface circuit breakers fitted to either side of the incoming circuit breakers. Customer or IDNO outgoing circuit breakers are fitted at each end the switchboard.

WPD's bus-section interface circuit breakers each include a metering VT and CTs but HV metering panels are only installed at customer connections.

Neutral voltage displacement protection cannot be provided by WPD and so if this is required (i.e. where the Agreed Export Capacity is $\geq 500\text{kW}$) it must be provided by the customer on their HV switchgear.

(b) Arrangement 6B

This arrangement consists of a WPD owned switchboard that includes one or more outgoing interface circuit breakers fitted to each end.

WPD's interface circuit breakers each include a metering VT and CTs but HV metering panels are only installed at customer connections.

Neutral voltage displacement (NVD) protection is provided by WPD as standard. Where NVD is not required this function is disabled within the protection relay settings.

(c) Arrangement 6C

This arrangement consists of a shared switchboard where WPD owns and operates the incoming circuit breaker/s only. All the other circuit breakers, including the bus-section installed between WPD's incomers are owned and operated by the customer or IDNO, as applicable.

WPD has no control over the bus-section circuit breaker and therefore WPD may not feed through the bus-section to back feed one of the incoming circuits. Given this, arrangement 6C may only be used where the two incoming circuits are dedicated to the HV customer / IDNO connection (i.e. no other substations are connected to the incoming circuits).

Where this arrangement is used one of the incoming circuit breakers shall be configured as a normal open point. WPD may provide automatic changeover facilities by programming WPD's network management system, if required.

The incoming circuit breakers each include a metering VT and CTs but HV metering panels are only installed for customer connections.

Neutral voltage displacement protection is provided by WPD as standard. Where NVD is not required this function is disabled within the protection relay settings.

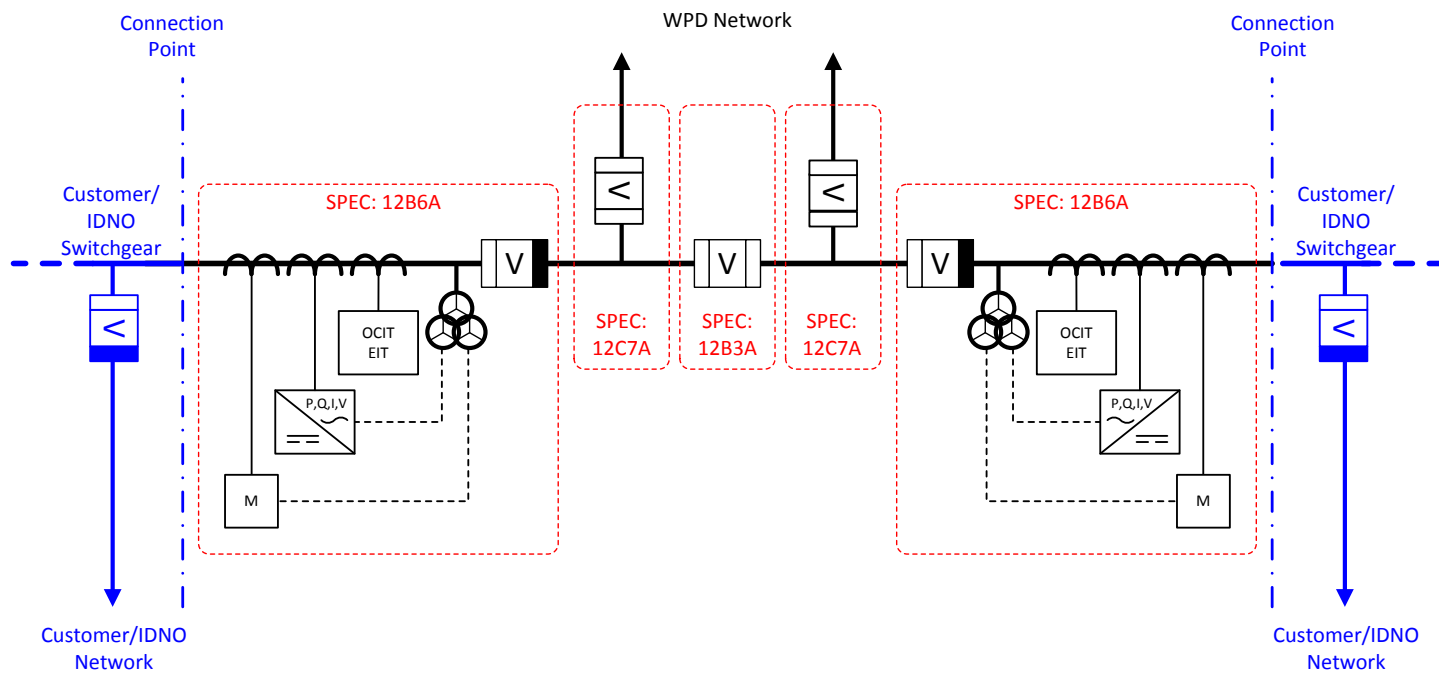


Figure 5 Arrangement 6A

Notes:

- *Metering panels are only provided at HV customer connections*

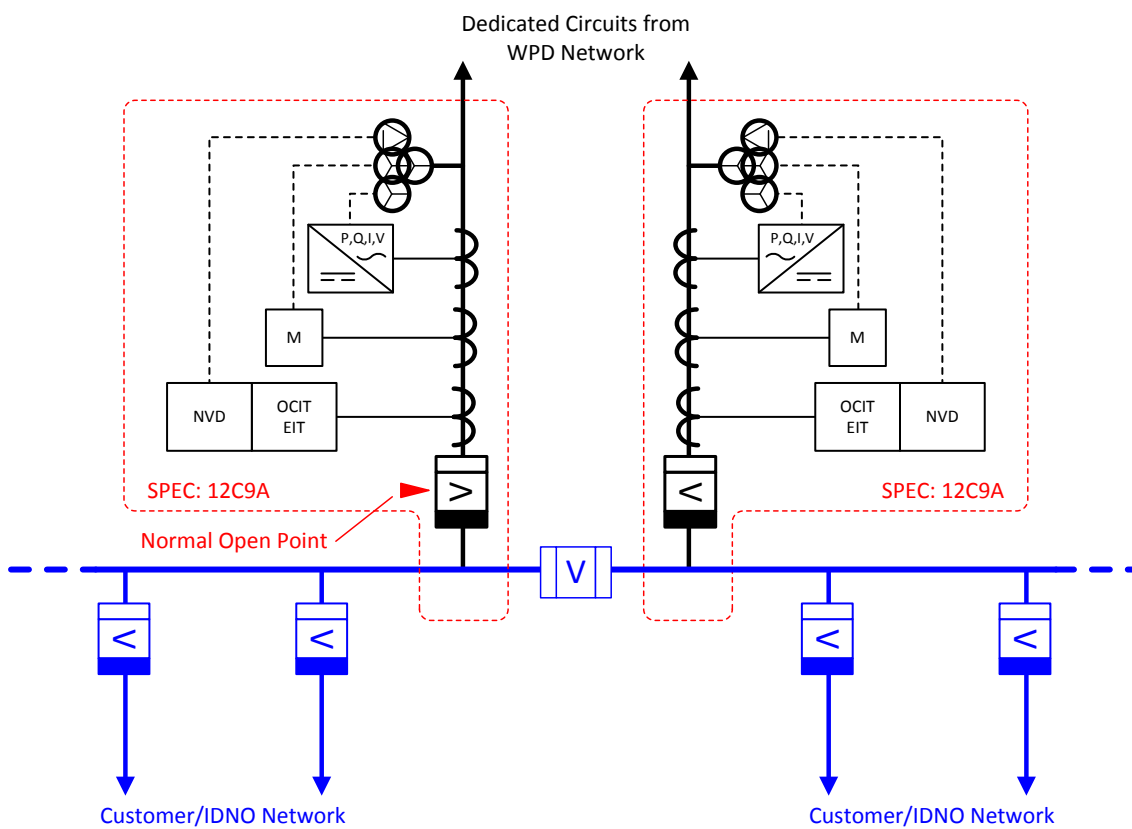


Figure 7 Arrangement 6C

Notes:

- Metering panels are only provided at HV customer connections

3.3 Arrangements Connected to WPD owned Parallel Circuits

Where additional security is required WPD may operate its HV circuits in parallel. Parallel arrangements are restricted to 100% cable networks and require more complex protection e.g. unit protection (pilot wire or current differential protection) and/or directional protection to be fitted.

If a circuit normally feeds one or more spans of overhead line, sensitive earth fault (SEF) protection must be fitted and this cannot be graded successfully where the circuits are operated in parallel.

Two basic **Primary Switchgear** arrangements, Arrangement 7 and 8, have been developed, each arrangement has a number of options. Figure 8 shows two of these options. Details of all the available arrangements and their options are described in the following sections.

A key to the single line diagrams is given in Appendix A.

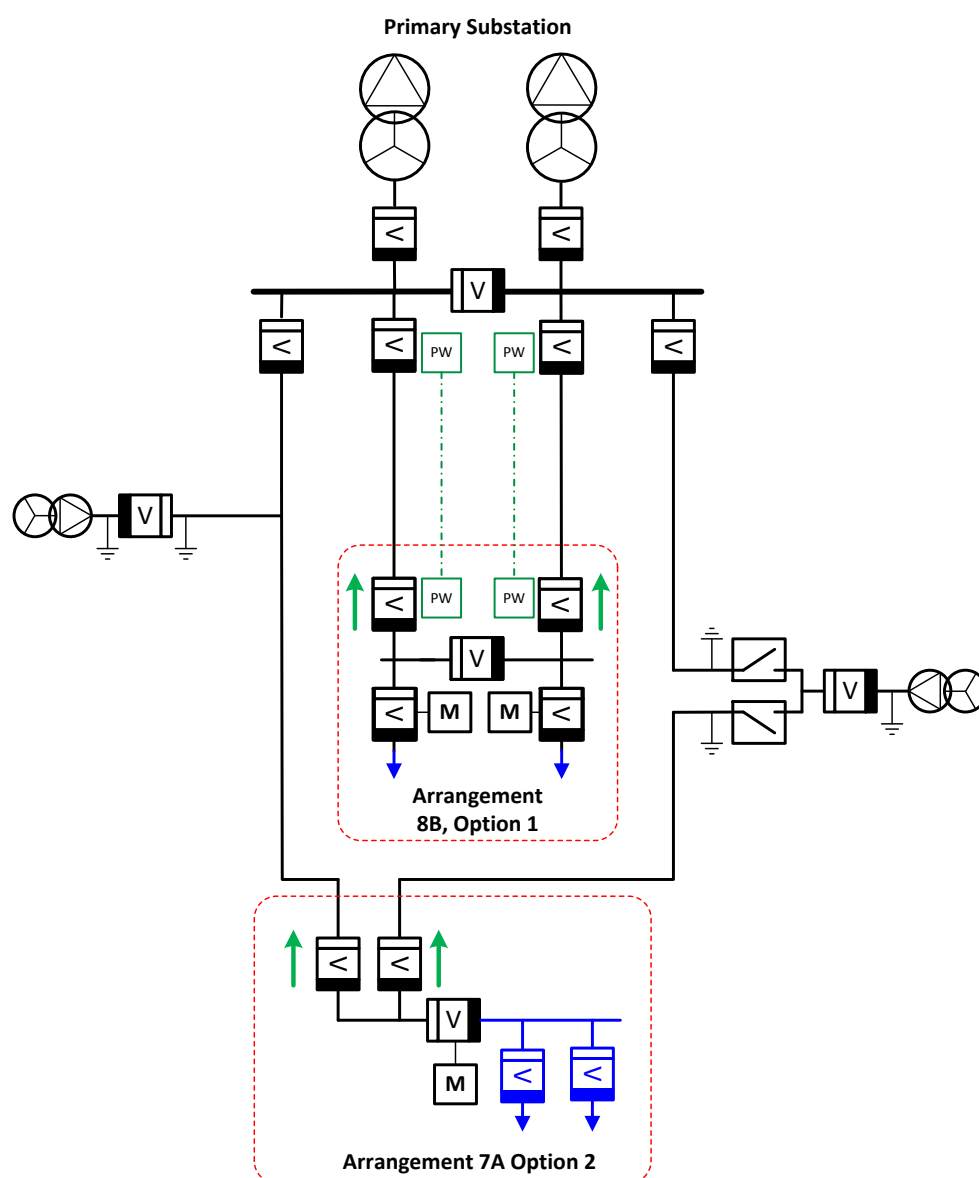


Figure 8 Example of Arrangement 8 and 9 installed within a Parallel Network

3.3.1 Arrangement 7

The basic arrangement consists of a switchboard with two WPD incoming 630A circuit breakers. Interface circuit breakers, also limited to 630A, are connected to one side of the incoming circuit breakers.

The two incoming circuit breakers are either fitted with unit protection (e.g. Translay, Solkor or biased current differential) and directional protection, or alternatively with directional protection alone. This protection provides discrimination for faults on each of the incoming circuits. The first option (unit protection with directional protection) is preferred as this provides faster protection clearance times.

Unit protection cannot be used if network substations are connected within the protective zones or if pilot cables or fibre optic cables are not available.

Two versions of Arrangement 7 are available, as described below:

(a) Arrangement 7A

This arrangement consists of a shared switchboard that includes a WPD owned bus-section interface circuit breaker fitted to one side of the board. Customer or IDNO outgoing circuit breakers are fitted at each end the switchboard.

WPD's bus-section interface circuit breaker includes a metering VT and CTs but HV metering panels are only installed at customer connections.

Neutral voltage displacement protection cannot be provided by WPD and so if this is required (i.e. where the Agreed Export Capacity is $\geq 500\text{kW}$) it must be provided by the customer on their HV switchgear.

Option 1 includes both unit protection and directional protection on the incoming circuit breakers whereas Option 2 only includes directional protection.

(b) Arrangement 7B

This arrangement consists of a WPD owned switchboard that includes one or more outgoing interface circuit breakers fitted to one end.

WPD's interface circuit breakers each include a metering VT and CTs but HV metering panels are only installed at customer connections.

Neutral voltage displacement (NVD) protection is provided by WPD as standard. Where NVD is not required this function is disabled within the protection relay settings.

Option 1 includes both unit protection and directional protection on the incoming circuit breakers whereas Option 2 only includes directional protection.

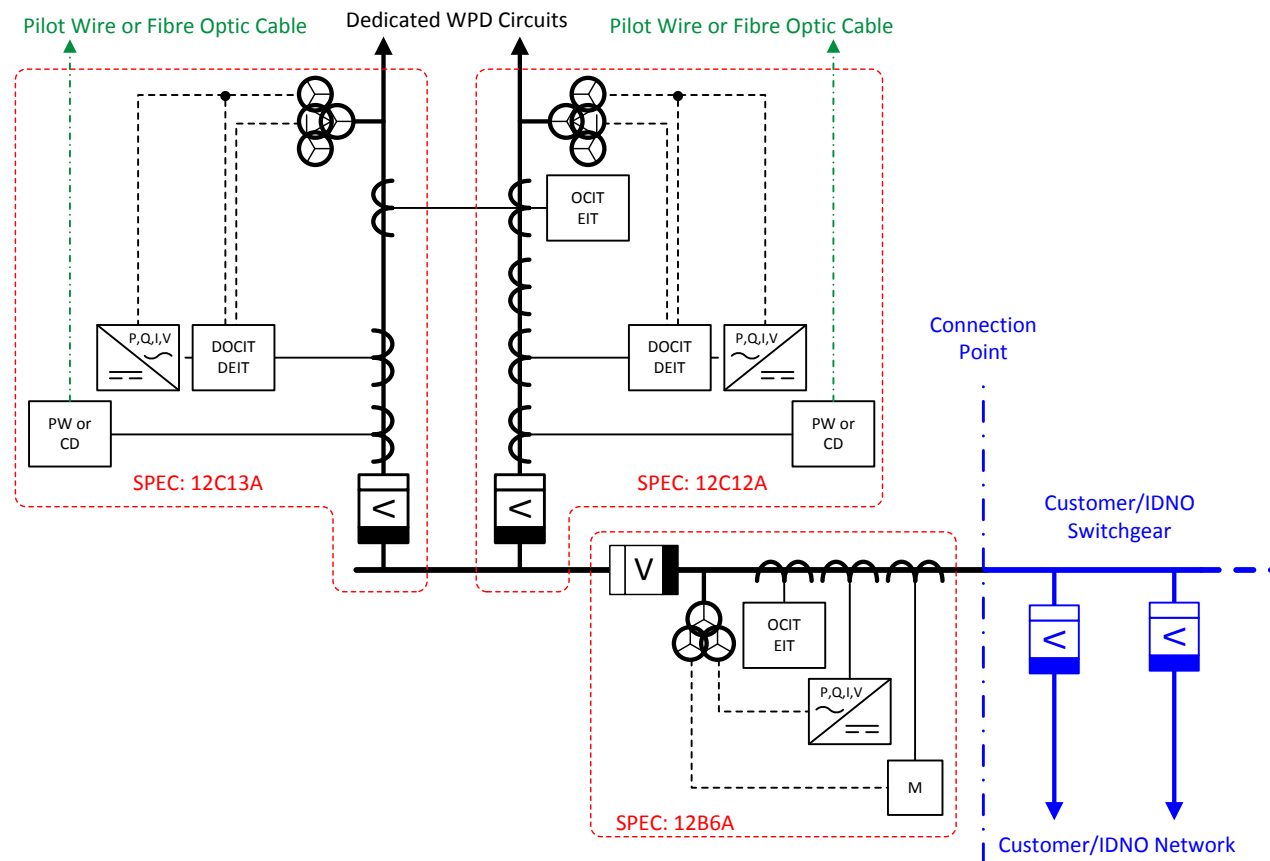


Figure 9 Arrangement 7A (Option 1)

Notes:

- HV Metering panels are only provided at HV customer connections

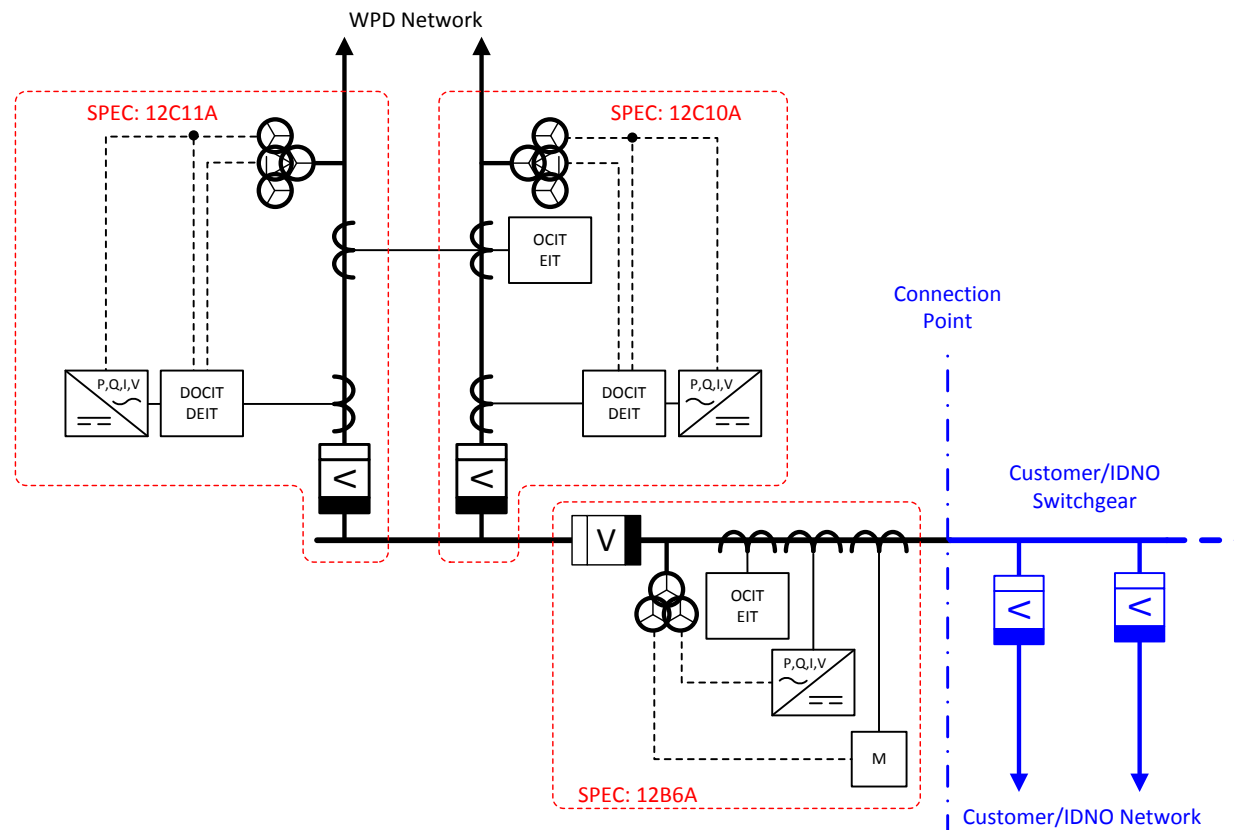


Figure 10 Arrangement 7A (Option 2)

Notes:

- *HV Metering panels are only provided at HV customer connections*

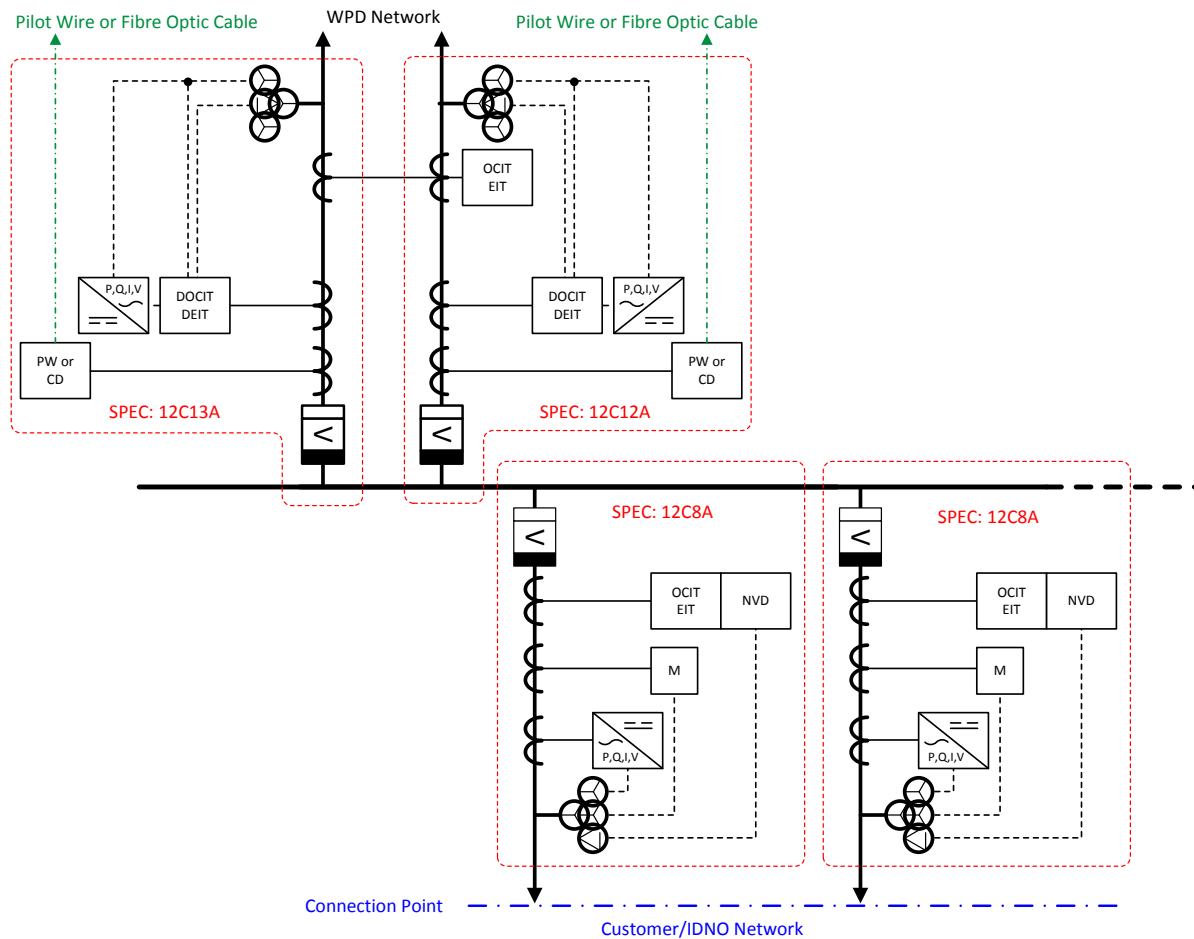


Figure 11 Arrangement 7B (Option 1)

Notes:

- HV Metering panels are only provided at HV customer connections
- The maximum distance between the **Connection Point** and customer circuit breaker/s is 100m. This does not apply to IDNO connections.

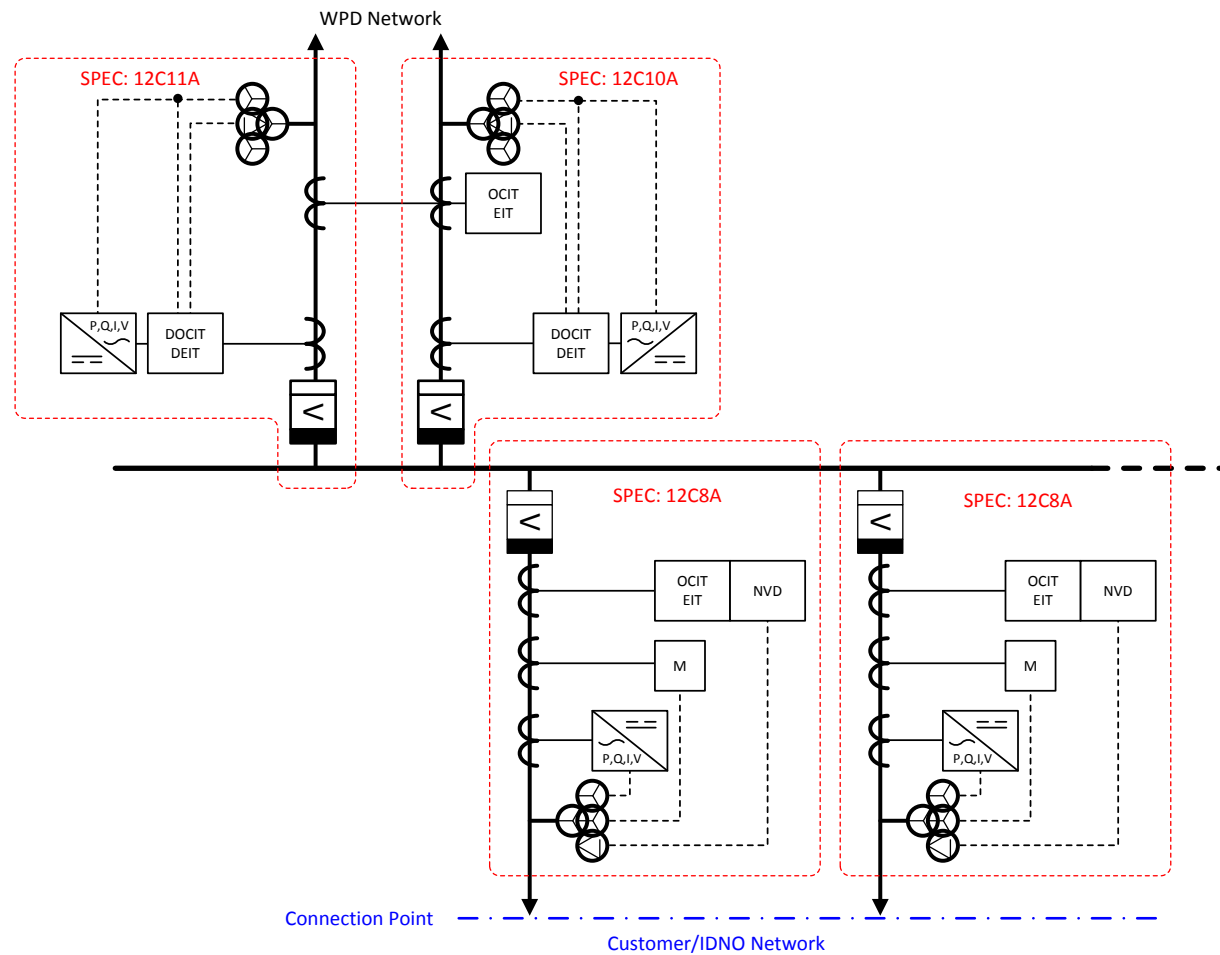


Figure 12 Arrangement 7B (Option 2)

Notes:

- HV Metering panels are only provided at HV customer connections
- The maximum distance between the **Connection Point** and customer circuit breaker/s is 100m. This does not apply to IDNO connections.

3.3.2 Arrangement 8

This arrangement consists of a switchboard with two WPD owned incoming circuit breakers separated by a bus-section circuit breaker. All WPD owned circuit breakers are limited to 630A.

The incoming circuit breakers are either fitted with unit protection (e.g. Translay, Solkor or biased current differential) and directional protection, or directional protection alone. This provides discrimination for faults on each of the incoming circuits. The first option (unit protection with directional protection) is preferred since this provides faster protection clearance times.

Unit protection cannot be used if network substations are connected within the protective zones or if pilot cables or fibre optic cables are not available.

Three variants, 8A, 8B and 8C are available:

(a) Arrangement 8A

This arrangement consists of a shared switchboard that includes two WPD owned bus-section interface circuit breakers fitted to either side of the incoming circuit breakers. Customer or IDNO outgoing circuit breakers are fitted at each end the switchboard.

WPD's bus-section interface circuit breakers each include a metering VT and CTs but HV metering panels are only installed at customer connections.

Neutral voltage displacement protection cannot be provided by WPD and so if this is required (i.e. where the Agreed Export Capacity is $\geq 500\text{kW}$) it must be by the customer on their switchgear.

Option 1 includes unit protection and directional protection on the incoming circuit breakers whereas Option 2 only includes directional protection.

(b) Arrangement 8B

This arrangement consists of a WPD owned switchboard that includes one or more outgoing interface circuit breakers fitted to each end.

WPD's interface circuit breakers each include a metering VT and CTs but HV metering panels are only installed at customer connections.

Neutral voltage displacement (NVD) protection is provided by WPD as standard. Where NVD is not required this function is disabled within the protection relay settings.

Option 1 includes unit protection and directional protection on the incoming circuit breakers whereas Option 2 only includes directional protection.

(c) Arrangement 8C

This arrangement consists of a shared switchboard where WPD owns and operates the incoming circuit breaker/s only. All the other circuit breakers, including the bus-section installed between WPD's incomers are owned and operated by the customer or IDNO, as applicable.

Whilst the bus-section circuit breaker is owned by the customer / IDNO its CTs and trip relays form part of the interface protection provided by WPD. Given this, it is essential that the bus-section circuit breaker meets WPD specification EE SPEC: 185, reference 12B5A.

The incoming circuits are designed to operate in parallel and therefore the customer / IDNO may operate with a closed or open bus-section, as required. When the customer or IDNO wishes to make or break the parallel across the incoming circuits this must be carried out with reference to, and with the agreement of, WPD's Control Centre.

The incoming circuit breakers require metering for HV customer connections but not for IDNO connections. Metering facilities are specified by adding the suffix "M" at the end of the specification reference. See EE SPEC: 185 for further information.

Neutral voltage displacement protection cannot be provided by WPD and so if this is required (i.e. where the Agreed Export Capacity is $\geq 500\text{kW}$) it must be provided by the customer on their HV switchgear.

Option 1 includes unit protection and directional protection on the incoming circuit breakers whereas Option 2 only includes directional protection.

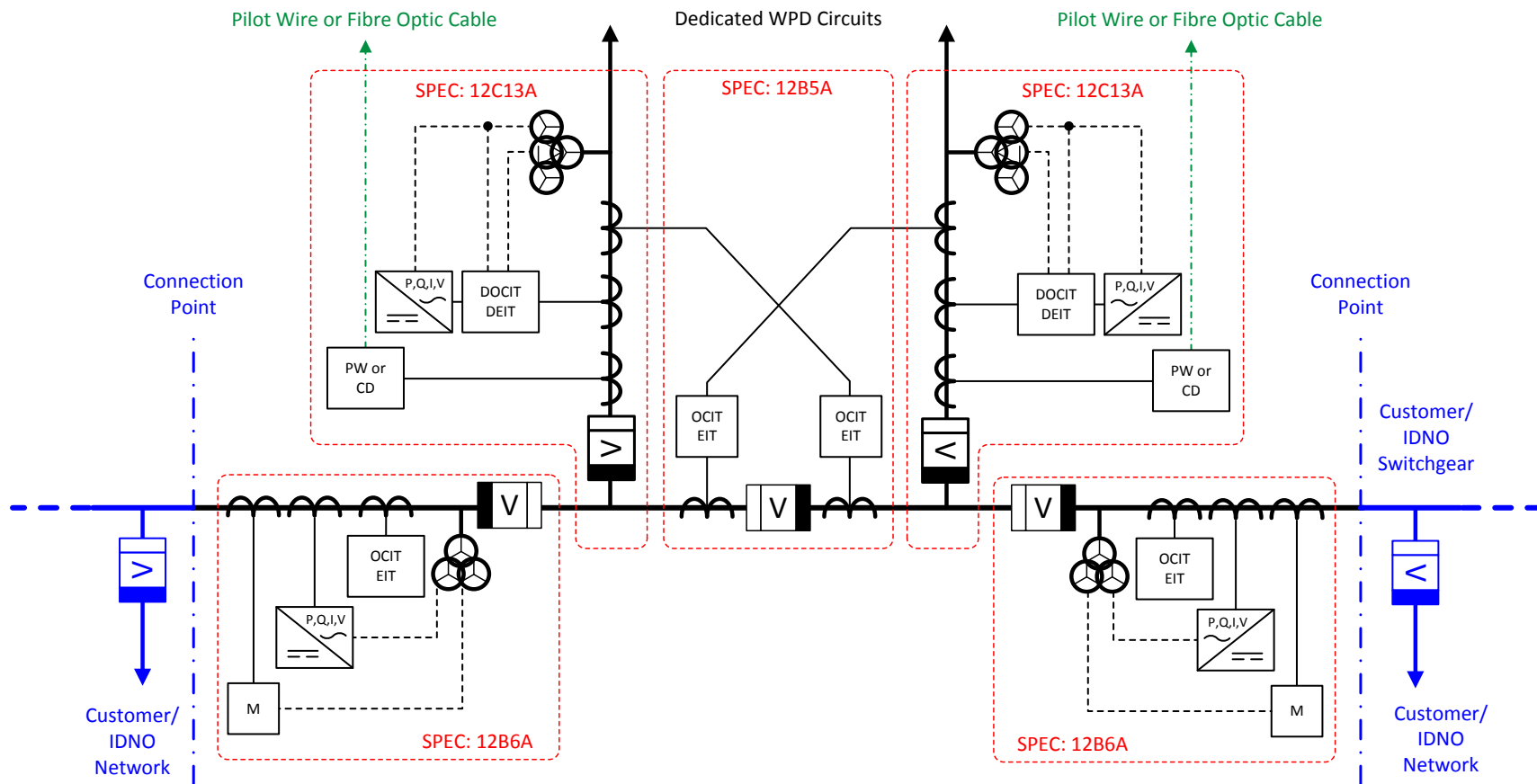


Figure 13 Arrangement 8A (Option 1)

Notes:

- HV Metering panels are only provided at HV customer connections

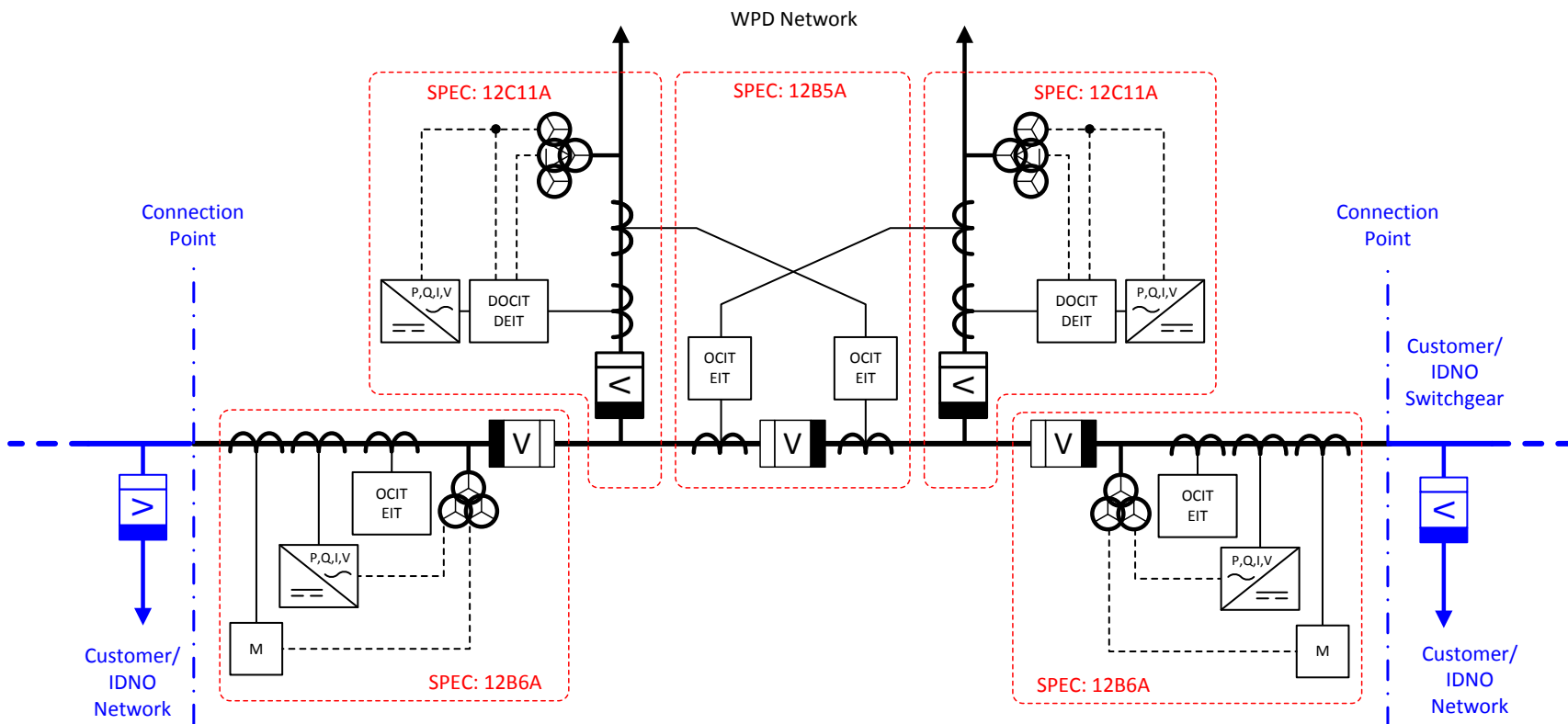


Figure 14 Arrangement 8A (Option 2)

Notes:

- *HV Metering panels are only provided at HV customer connections*

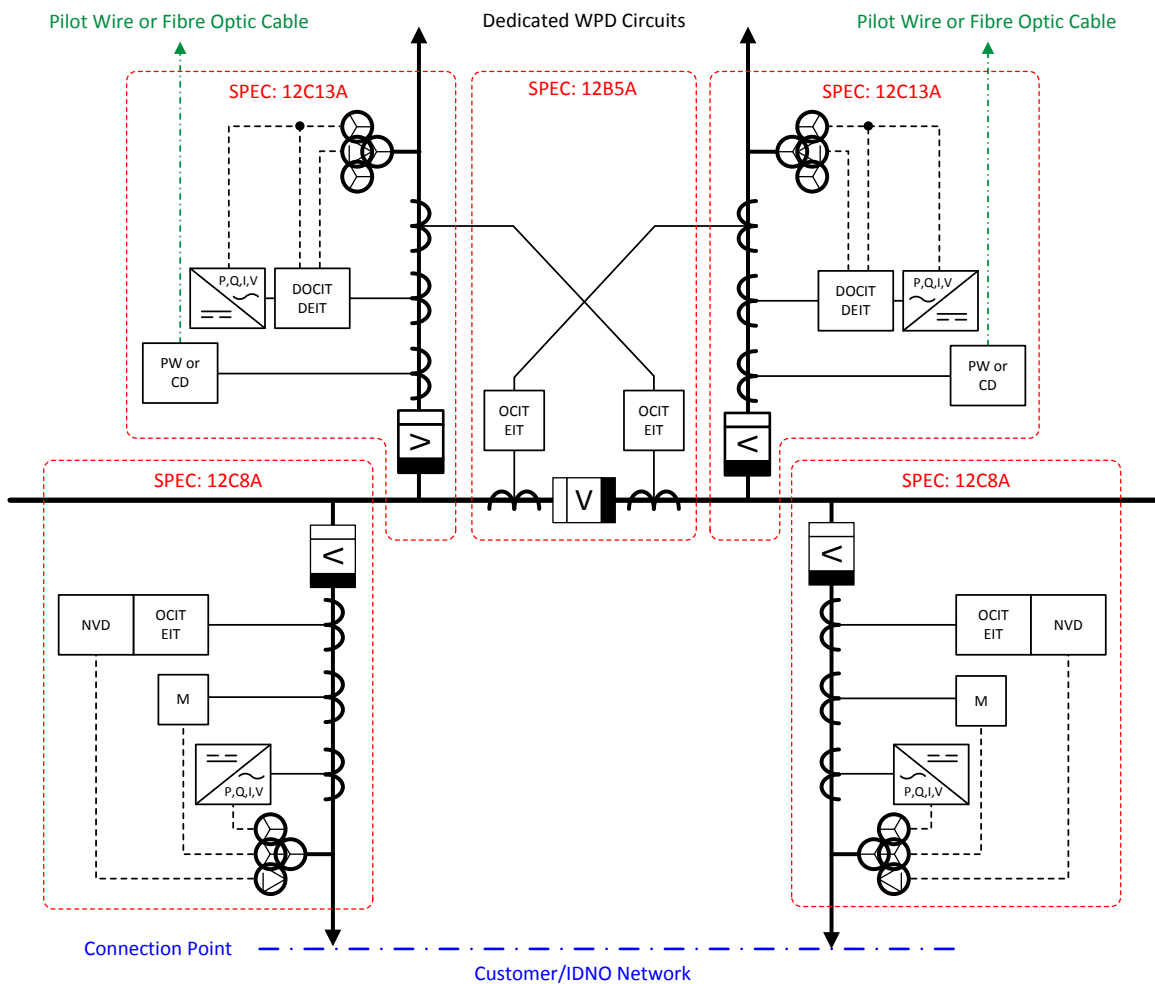


Figure 15 Arrangement 8B (Option 1)

Notes:

- HV Metering panels are only provided at HV customer connections
- The maximum distance between the **Connection Point** and customer circuit breaker/s is 100m. This does not apply to IDNO connections

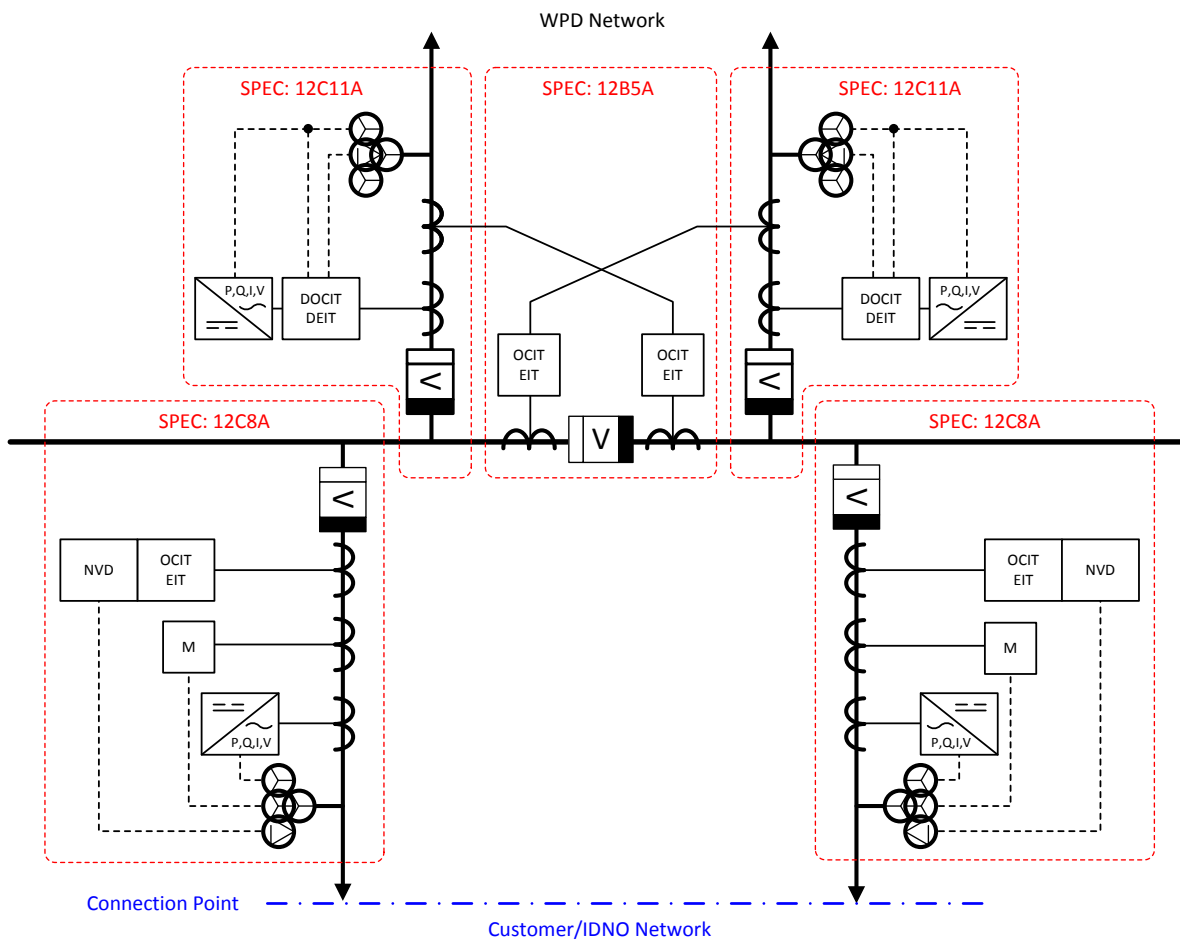


Figure 16 Arrangement 8B (Option 2)

Notes:

- HV Metering panels are only provided at HV customer connections
- The maximum distance between the **Connection Point** and customer circuit breaker/s is 100m. This does not apply to IDNO connections

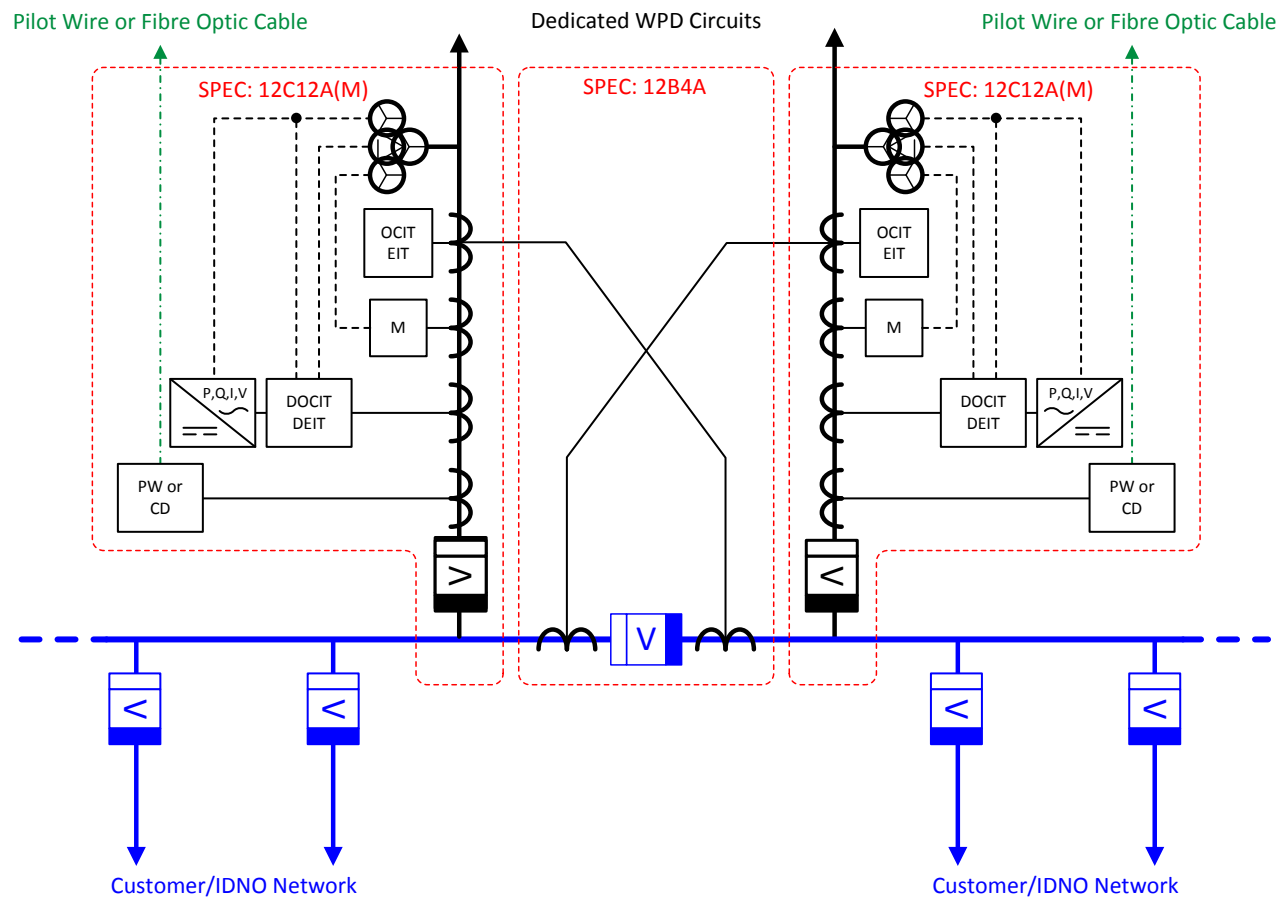


Figure 17 Arrangement 8C (Option 1)

Notes:

- HV Metering panels are only provided at HV customer connections

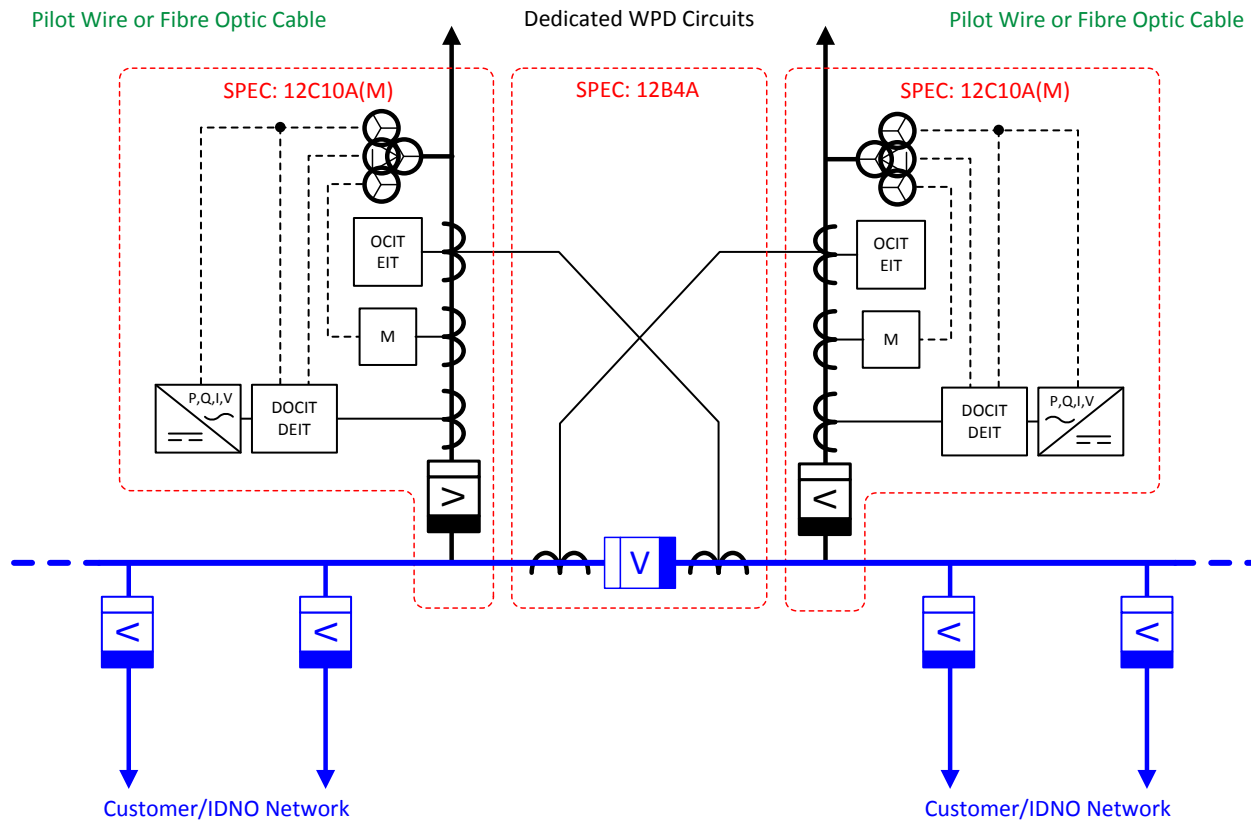


Figure 18 Arrangement 8C (Option 2)

Notes:

- *HV Metering panels are only provided at HV customer connections*

3.4 Primary Substation Arrangements

HV customer connections and IDNO connections may be provided directly from an 11kV or 6.6kV, primary substation switchboard, as applicable. Two basic options are available, Arrangement 9 and Arrangement 10, as described below.

HV customer connections require metering facilities to be provided at the primary substations. Where this is the case WPD shall provide access to the customer and meter operator / meter reader on request.

3.4.1 Arrangement 9

Arrangement 9 consists of a wholly WPD owned primary substation and HV switchboard with one or more outgoing 630A interface circuit breakers. Two options, 9A and 9B are available that are suitable for HV metered connections and IDNO connections respectively.

(a) Arrangement 9A

This arrangement is applicable to HV metered connections only. WPD outgoing metering circuit breakers are provided with metering VTs and metering CTs. IDMT phase fault, earth fault and NVD (neutral voltage displacement protection is provided as standard. If NVD is not required it is disabled in the relay settings.

Additional non-standard protection functions may be requested by the customer (e.g. unit protection etc.). Where this is the case details shall be discussed and agreed with the Policy Section and Engineering Design.

(b) Arrangement 9B

This arrangement is applicable to IDNO connections only. WPD owned outgoing interface circuit breakers are provided with IDMT phase fault and earth fault protection as standard.

Additional, non-standard, protection functions may be requested by the IDNO. Where this is the case details will shall be discussed and agreed with the Policy Section and with Engineering Design.

3.4.2 Arrangement 10

Arrangement 10 consists of a WPD primary substation with a joint HV switchboard. WPD owned incoming transformer circuit breakers also act as interface circuit breakers. The two options, 11A and 11B are suitable for HV metered connections and IDNO connections respectively.

(a) Arrangement 10A

This arrangement is applicable to HV metered connections only. WPD incoming metering circuit breakers are provided, each with a metering VT winding and metering CTs. Partial differential protection is used to provide phase fault and earth fault protection at the **Connection Point**.

(b) Arrangement 10B

This arrangement is applicable to IDNO connections only. WPD incoming interface circuit breakers include partial differential protection which provides phase fault and earth fault protection at the **Connection Point**.

Both arrangement 10A and 10B use non-standard protection / switchgear configurations, however, the general requirements shall be in accordance with EE SPEC 185. Detailed requirements shall be discussed and agreed with the Policy Section and with Engineering Design before ordering.

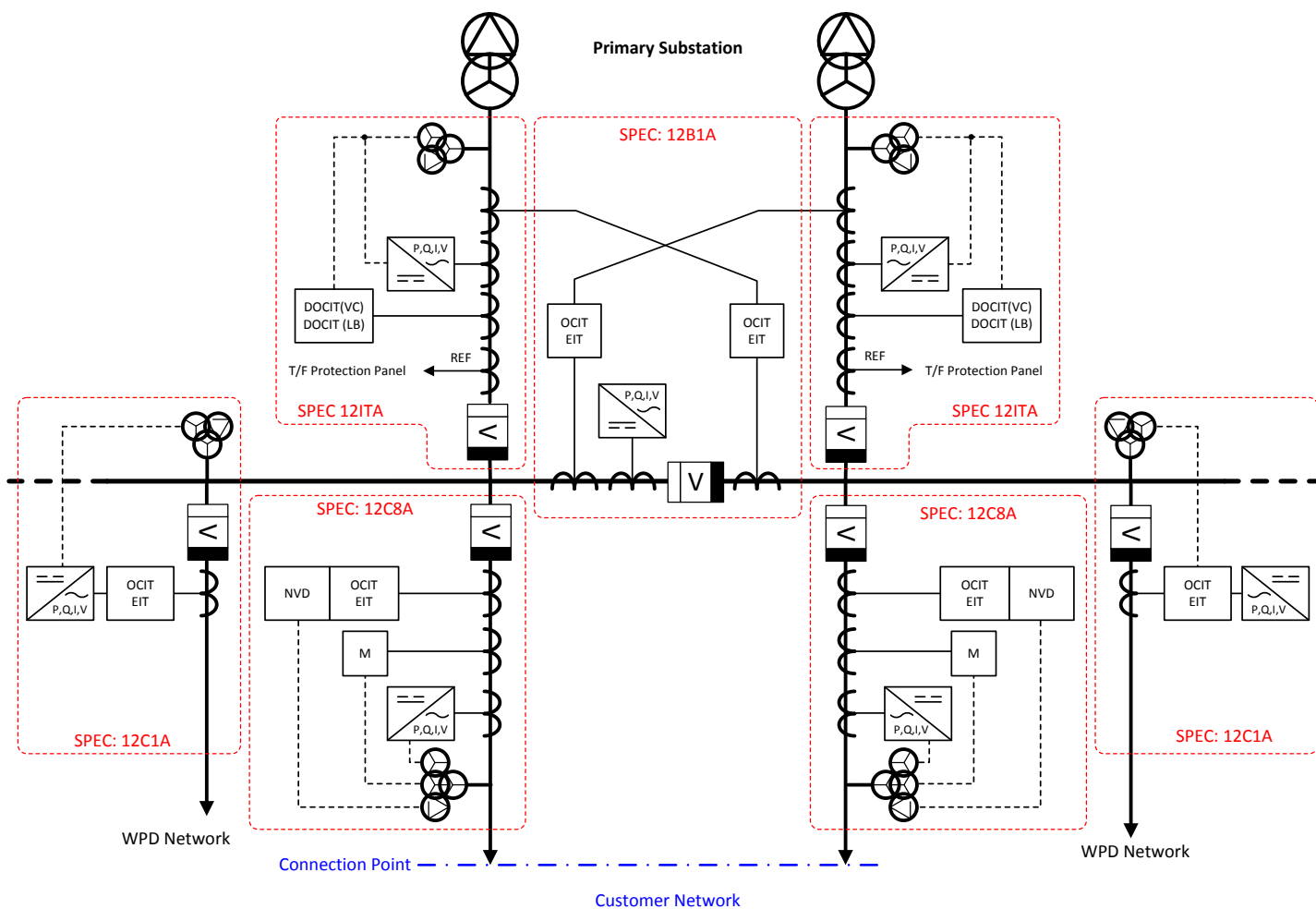


Figure 19 Arrangement 9A

Notes:

- Suitable for HV customer connections only
- The maximum distance between the **Connection Point** and customer circuit breaker/s is 100m

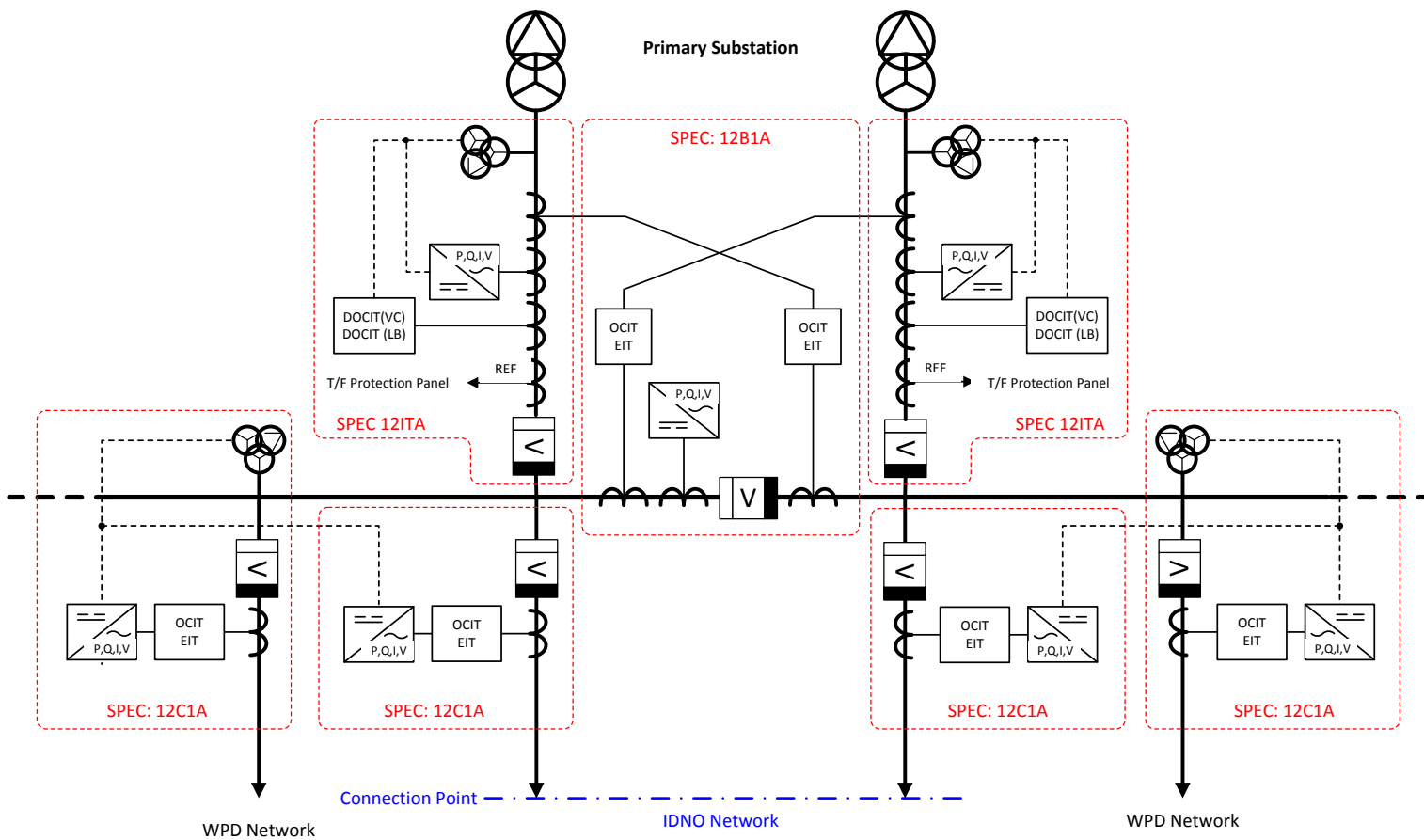


Figure 20 Arrangement 9B

Notes:

- *Suitable for IDNO connections only*

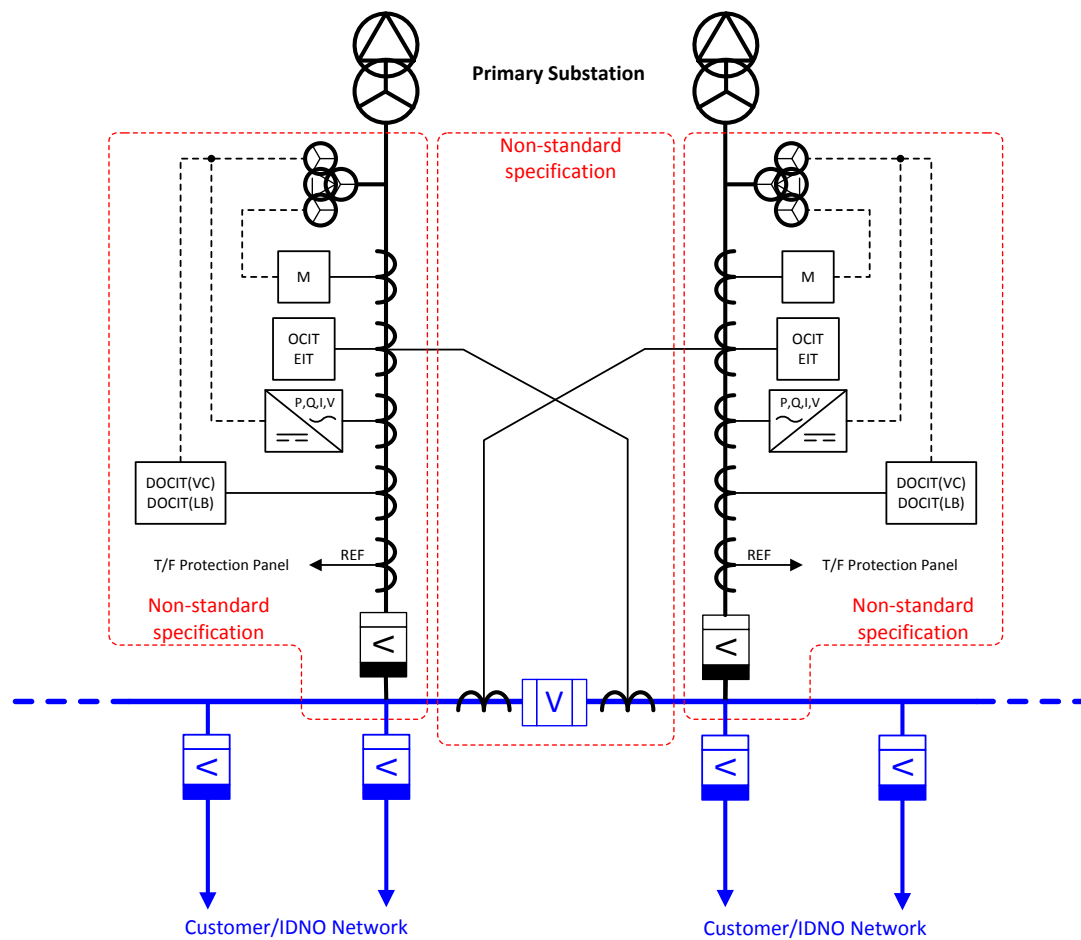


Figure 21 Arrangement 10A

Notes

- Suitable for HV customer connections only
- The maximum distance between the **Connection Point** and customer circuit breaker/s is 100m

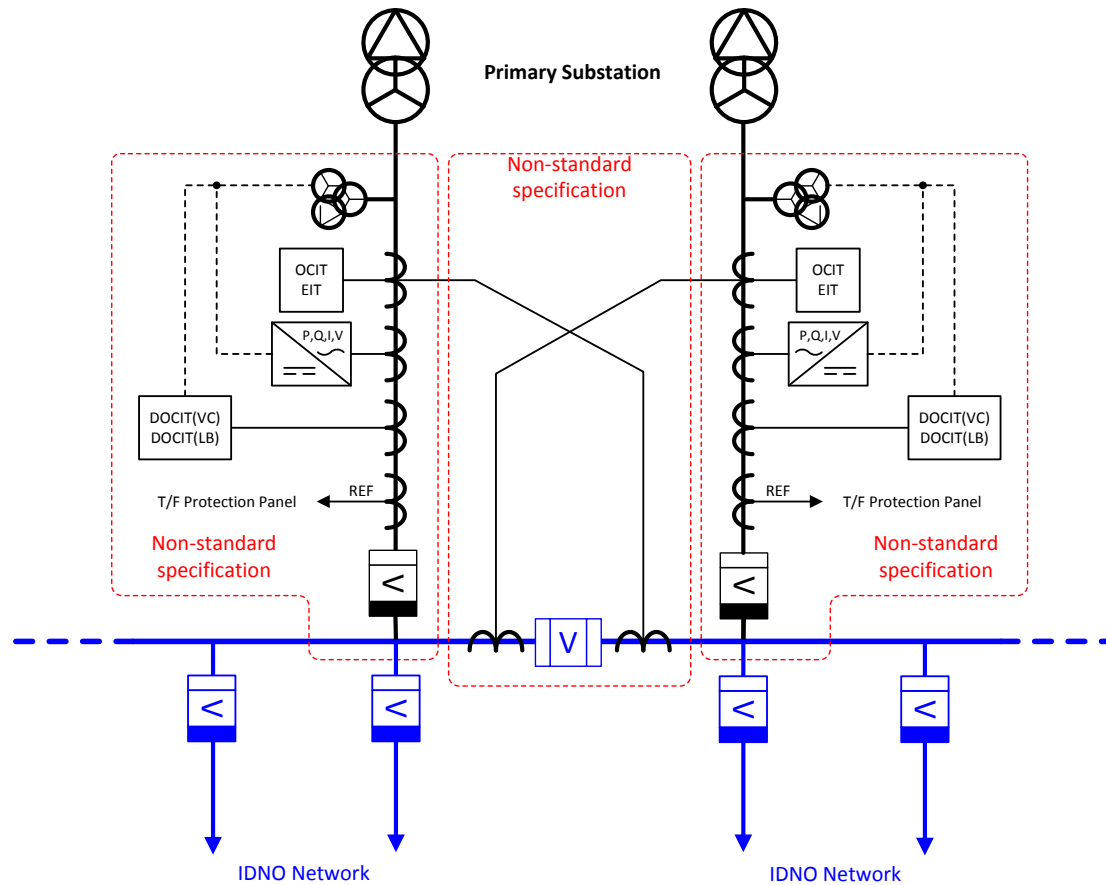


Figure 22 Arrangement 10B

Notes:

- *Suitable for IDNO connections only*

3.5 High Capacity Connections

Arrangement 8B, 8C, 9A and 9B may be adapted / extended to provide higher capacity connections, where required:

Typical examples are provided in Figure 23 and 24.

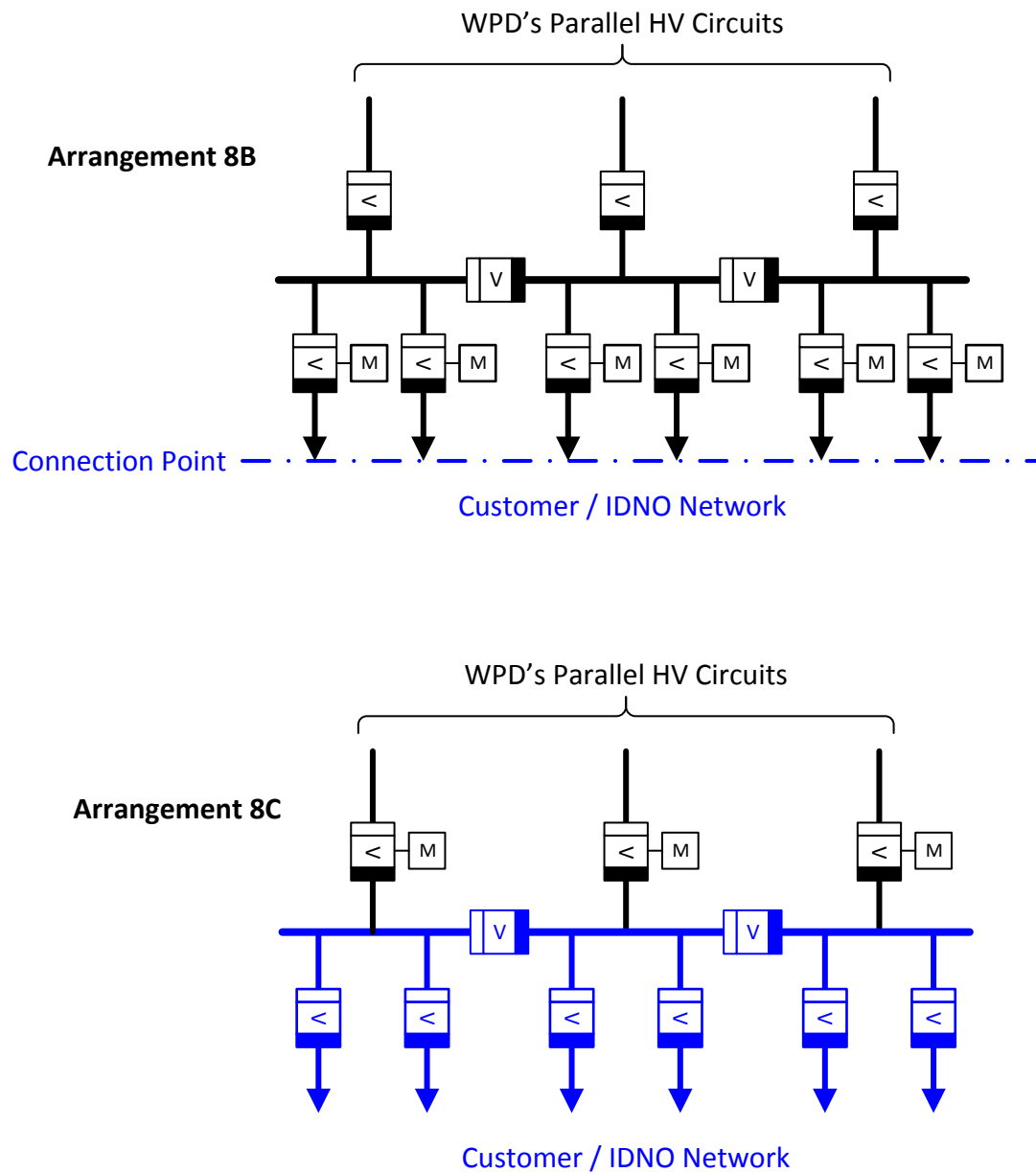


Figure 23 High Capacity Connections based on Arrangement 8B and 8C

Notes

- HV Metering panels are only provided at HV customer connections

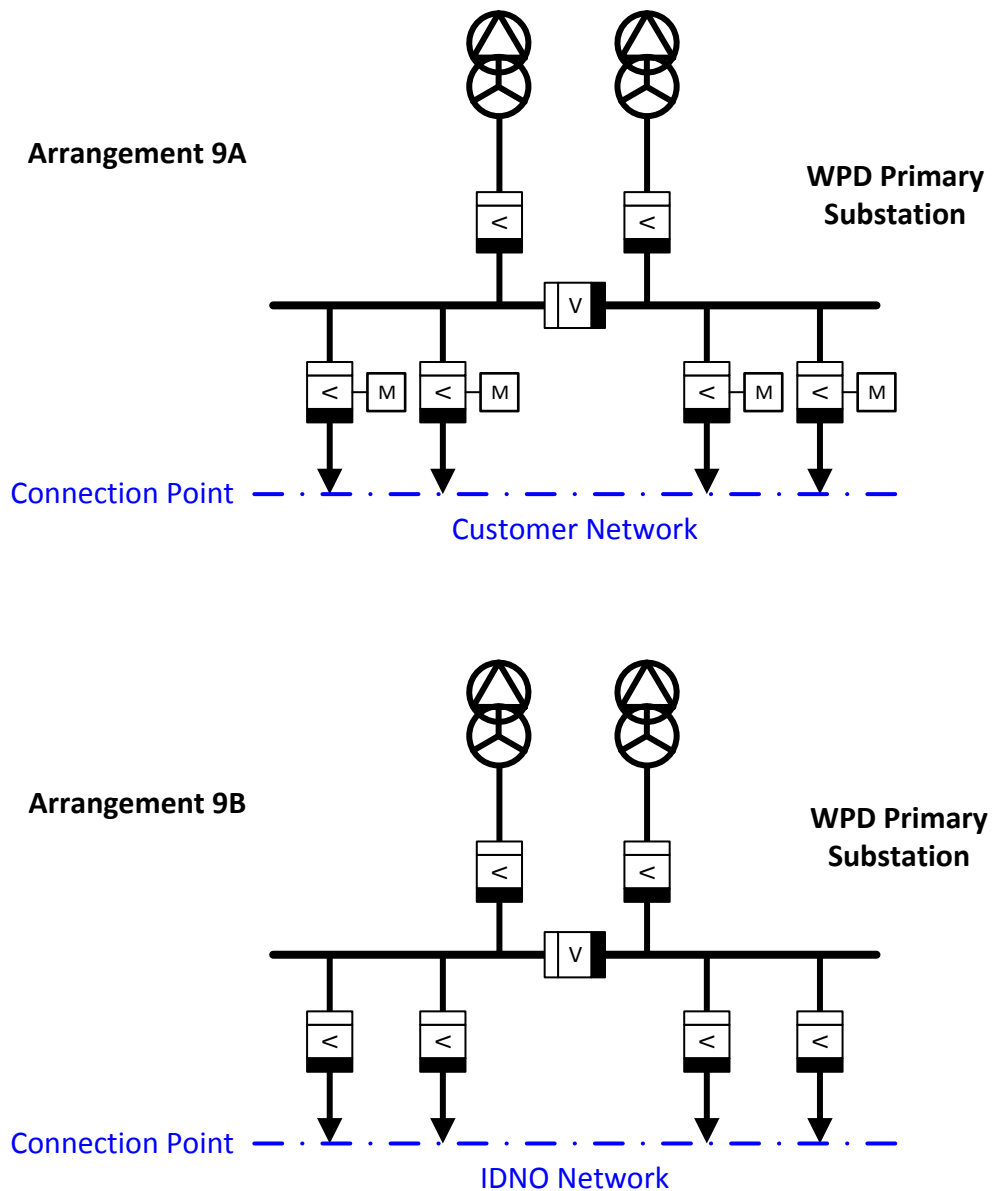


Figure 24 High Capacity Connections based on Arrangement 8B and 8C

Notes

- HV Metering panels are only provided at HV customer connections

4.0 SUBSTATION LOCATION

For secondary substations, the switchroom / enclosure containing WPDs switchgear shall be located:

- At least 9 meters from LV metalwork including steel framed buildings where the site is deemed to be hot (see also Section 7 on earthing requirements)
- At least 5m from the living areas and bedrooms of domestic properties and other residential properties, care homes, hotels etc. This requirement is designed to control the risk of noise complaints.

In the case of primary substations the minimum distance between the substation boundary and LV metalwork and buildings shall be determined on a site specific basis. Guidance on the earthing requirements is provided by Primary System Design and guidance on noise issues is provided by the Policy Section.

For HV customer connections WPD's metering circuit breakers shall be located:

- Within 20m of the metering room and meter panel/s subject to complying with section 9.2.
- Within 100m of the HV customer's incoming switchgear. This requirement limits the length of customer cable and the amount of customer equipment protected and isolated by WPD's protection and switchgear.

For HV IDNO connections where the IDNO provides a HV customer connection but does not own / operate their own HV switchgear, WPD's circuit breaker shall be located within 100m of the HV customer's incoming switchgear.

New customer buildings or extensions constructed after WPDs substation / switch room has been established shall not encroach within the minimum separation distances defined above.

WPD's plant and equipment shall be easily accessible to WPD staff at all times (24 hours per day, 365 days per year) for operational purposes for the maintenance / replacement of WPD's equipment.

The location shall be assessed for risk of flooding from rivers, sea (tidal), ground saturation (rain) and drainage capacity. WPD's mapping systems provides information regarding flood risk areas and probability. Further information is provided in Section 5.7 and in POL SP9.

Any substation installations in or adjacent to controlled waters, the sea, flood defences or flood plains shall comply with the requirements stated within ST: GE19A.

5.0 SWITCHGEAR ACCOMMODATION

WPD plant and equipment shall be accommodated within an appropriate building or enclosure designed to protect the structure and its contents from damage or risks to health and safety due to the effects of weather, water / moisture, dust penetration and where applicable falling objects, for the nominal life expectancy of the plant. Further details are provided below and also in ST: SD1V. Furthermore, WPD have produced some generic designs which can be accessed from the following link:

[ENGINEERING DESIGN MANUAL\WPD Policy Documents\SD4OB](#)

5.1 General

WPD prefer **Primary Switchgear** to be accommodated in a masonry constructed building with pitched slate/tiled roof as this provides a robust, low-maintenance, vandal resistant, stable and cost effective environment. Notwithstanding this preference, it is recognised that customers and IDNOs may wish to use a modular or containerised steel or GRP solution in order to minimise the site construction phase.

Switchrooms shall allow sufficient space to accommodate switchgear and associated protection panels, ancillary equipment / systems and shall afford sufficient operator access and emergency egress. The space required for WPD's load management panels and SCADA RTUs, where specified is listed in Table 1, below.

WPD's Engineering Design department will assess building designs against switchgear manufacturer recommended horizontal and vertical clearances. Where building designs do not meet these requirements WPD will require the installer (e.g. the Independent Connection Provider) to obtain formal confirmation from the manufacturer that there is no adverse effect on the functional performance of the switchgear or the safety of WPD staff / contractors.

Panel Type	Dimensions	Further Details
WPD SCADA RTU (Remote Terminal Unit)	800mm high x 600mm wide x 400mm deep	Wall mounted panel with bottom entry cable glands and a full front door hinged on the right. Gross weight circa 50kg
WPD Load Management Panel (e.g. GCP or ANM panel)	800mm high x 800mm wide x 400mm deep	Wall mounted panel with bottom entry cable glands and a full front door hinged on the left. Gross weight circa 70kg

Table 1 Dimensions of Load Management SCADA RTU Panels

Sufficient space / clearance shall be allowed to enable primary plant (e.g. switchgear) to be removed without the removal of other equipment (e.g. protection panels, wall boxes, battery systems etc.) and vice versa. Door swings shall be taken into account when considering space requirements.

Depending on the make / model of switchgear that is selected, routine personnel access to the rear of the switchboard may be required. In such cases an unobstructed passageway of 750mm width shall be provided.

5.2 Cable Access

A suitably configured / sized sub-structure trench area shall be provided under the switchgear to ensure the safety of site personnel during cable installation and removal. This area will require a depth of at least 1200mm with sub-structure duct inverts set 200mm above the trench floor to afford clearance for cable manipulation. The trench shall include a defined means of direct access / egress from within the substation that avoids the trench being classified as "a confined space". Designs shall allow for a cable bending radius of at least 1000mm.

5.3 Switchgear Overpressure Vent Provisions

The building / enclosure shall be designed to meet the manufacturer's requirements for over-pressure venting. The building shall include control measures that prevent an over-pressure event from causing structural damage to the building superstructure. Control measures may include, but are not restricted to:

- Designing the enclosure to withstand the anticipated overpressure.
- Providing sufficient internal dimensions within the enclosure to safely dissipate the overpressure.
- Provide dedicated vents located at appropriate positions on the superstructure to control the overpressure.
- Provide overpressure venting direct from the switchgear via dedicated ductwork to a safe position outside of the building.

5.4 Structural Loads

The enclosure shall be designed in accordance with the codes of practice relevant to the proposed structural materials and shall adequately carry and transmit to the natural foundation all dead, imposed and wind loads. Trench steelwork supports shall be specified to withstand static loads from the switchgear and an additional imposed load of 1.5kN/m^2 to allow for pedestrian access. Where switchgear or elements thereof are likely to be rolled over trenches during installation / removal, all elements shall be suitable rated for this purpose.

5.5 Fire Resistance / Fire Exit Provisions

The enclosure shall be designed to provide a minimum fire resistance of 1 hour. All dedicated fire escape routes shall be at least 750mm wide and all escape doors shall be provided with internal panic crash bar / pad release devices.

5.6 Durability and Moisture Resistance

The design life of the enclosure shall, unless otherwise agreed, be a minimum of 50 years and every effort shall be made to specify materials with minimised structure / fabric maintenance requirements (although it is accepted that maintenance responsibility will rest with the customer or IDNO, as applicable). The enclosure shall be designed to protect the structure and its contents from damage or risks to health and safety due to the effects of weather, water / moisture penetration and ground contaminants. The enclosure shall be designed to adequately collect and convey rain / storm water to a suitable point of disposal.

5.7 Avoidance of Flooding

External ground / access road levels shall be designed so there is no detrimental build-up of surface water in the proximity of the enclosure. Unless appropriate protective measures are proposed by the customer / installer and agreed with WPD the switchroom shall be positioned to minimise flood risk. In practicable terms, the switchroom floor level shall be at least 500mm above the higher of the 1 in 100 year fluvial flood level, the 1 in 100 year pluvial flood level and 300mm above the 1 in 200 year tidal level. Cable ducts, cut-outs and entries into the switchroom shall be designed so they do not breach any flood defences / protective measures. In addition, where site topography suggests there is a potential risk of excessive surface water runoff under extreme weather conditions the switchroom floor shall be raised 500mm above the surrounding ground.

The substructure of the enclosure / building shall be tanked / sealed / treated to prevent water ingress. All substructure duct entries shall be sealed around cables using WPD approved products. A suitable sump shall be formed within the substructure trench area to assist with the removal of surface / ground water during construction. A maintenance free submersible pump with float-switch actuation shall be permanently installed within the sump, with discharge to a suitable point of disposal.

5.8 Internal surfaces

Internal surfaces within the enclosure / building that may otherwise cause dust to propagate (masonry/concrete etc.) shall be effectively sealed by the application of appropriate paints/sealants etc.

5.9 Security / Access Doors

The enclosure shall be constructed with no areas of glazing and designed to prevent any unauthorised entry or access to the electrical plant / equipment. Appropriate safety / warning / danger signs and notices shall be permanently displayed.

All double / single leaf entry doors shall be outward opening and constructed from robust, vandal resistant, durable, maintenance free hardwood, steel or GRP construction meeting an LPCB security rating. They shall be fitted with a secure locking arrangement with panic exit provision capable of receiving a Euro profile locking cylinder, which will be supplied and fitted by WPD. All door hinges shall be heavy duty and vandal resistant with concealed fixings.

Double leaf entrance doors, where supplied, shall be designed such that the right hand leaf (viewed from outside) will pen first. The meeting stiles shall be rebated / overlap or otherwise be resistant to prising. The left hand leaf shall be fixed internally by short top and bottom sliding bolts into receptors within the frame head and cill.

Heavy duty door restraints shall be fitted at the head of each door leaf and shall be capable of holding the doors open at 90 degrees.

5.10 Thermal Performance / Insulation

The switchroom shall be designed to deliver a maximum target U-value of $0.45\text{W/m}^2\text{K}$. Any risk of condensation build up at cold-bridging points shall be mitigated. This is of a particular importance on the underside of switchgear and control gear.

6.0 OWNERSHIP BOUNDARIES

The ownership boundary is either the HV cable termination or the busbar connections inside the switchgear, depending on the arrangement.

Where the boundary is the cable termination the customer or IDNO, as applicable, is responsible for making and paying for the termination. The Customer / IDNO cable/s, which are connected to the WPD Owned HV metering unit/s, shall conform to BS 7870: Part 4.10 2011 and all terminations shall be cold shrink type, complete with cold applied boots, type tested to the latest version of HD 628 or HD 629.

The ownership and ownership boundary of the switchgear and other items of equipment shall be agreed and recorded in the Connection Agreement. This could include, but is not limited to the ownership of:

- Battery charger systems
- Multicores, pilots and fibre circuits running between WPD equipment and customer / IDNO equipment
- Protection panels and interface cabinets
- LV auxiliary supplies
- Buildings / enclosures

7.0 LEGAL REQUIREMENTS

Substations, cables, overhead lines and operational access areas shall have suitable land rights in accordance with the current Estates and Wayleaves suite of documents.

8.0 EARTHING

Detailed earthing requirements are specified in ST: TP21D, ST: TP21B and EE SPEC: 89. All arrangements specified in this document are deemed to be major substations within the scope of ST: TP21B. Further guidance on earthing may be sought from the earthing specialists in Primary System Design.

The HV earth electrode associated with WPDs switchgear shall be owned and maintained by WPD. WPD's HV earth electrode shall, as a minimum, satisfy the requirements Section 4 of ST: TP21D when considered in isolation from any customer HV earth electrode.

Where WPD's HV equipment and the customer's / IDNO's HV equipment is installed in close proximity of each other (e.g. within 10 meters) they should be bonded directly together using copper conductor with a minimum cross-section of 35mm². This helps to reduce the resistance of the overall HV earthing system and helps to minimise any differences in potential between WPD and customer / IDNO equipment.

Where WPD's HV equipment and that of the customer / IDNO is not installed in close proximity to each other direct bonding between the two systems is not normally provided. Despite this the electrodes are normally connected together indirectly via HV cable screens.

The owner of any HV/LV transformers is responsible for deciding whether to combine or segregate the associated HV and LV earthing systems. Irrespective of this decision the transformer owner shall ensure the earth electrodes are designed, installed and used in such a manner to prevent danger occurring in any low voltage network as a result of any fault in the HV network.

Where the HV and LV earth electrodes are segregated a minimum distance of 2.5m above ground must be maintained between HV metalwork and any LV bonded metalwork to prevent anyone touching both earth references simultaneously. A minimum segregation distance of 9m is required between HV and LV bare buried electrode / buried metalwork but this distance may need to be extended in some situations.

9.0 SETTLEMENT METERING AT CUSTOMER CONNECTIONS

9.1 Metering Codes of Practice

All HV customer connections shall be provided with metering facilities that satisfy the requirements of Metering Code of Practice 2 (COP 2) or Metering Code of Practice 3 (COP 3) as applicable.

- COP2 is applicable to circuit ratings up to 100MVA
- COP3 is applicable to circuit ratings up to 10MVA

Metering CTs, VTs and ancillary equipment associated with WPD **Primary Switchgear** satisfy the more onerous requirements of COP 2, as standard.

9.2 Ownership of Metering Equipment

WPD's distribution business owns, operates and maintains the:

- Metering CTs and VTs,
- HV metering circuit breakers,
- Multicore cables between the WPDs equipment and the metering panel,
- Fuses, links and terminals within the metering unit etc.,
- Multicore termination blocks, the safe access terminal blocks (SATB) and isolation fuses and links at the interface between WPD's equipment and the Supplier' (i.e. Meter Operator's) equipment.
- Cubicle / panel that contains the multicore termination blocks, SATB and isolation fuses and links. This is often the meter panel itself.

The Supplier and appointed Meter Operator is responsible for providing the:

- Meters,
- Meter control equipment,
- Any additional test terminal blocks
- Any additional fuses and links on the meter panel beyond WPD's isolation facilities,
- Communication equipment, if required.

9.3 Metering Requirements

Meter panels and associated isolation facilities shall be installed within a weather proof room or enclosure that provides adequate shelter for the apparatus when the access doors are closed and also when the doors are opened for meter reading / operational activities. The environment must be fairly cool (normally between 5°C and 20°C and in no circumstances above 30°C. There shall not be any significant heat sources (e.g. boilers etc.) in the vicinity that could overheat the equipment.

The metering room/enclosure shall be easily accessible without the need to enter WPD's switchroom / substation and shall be in close proximity to WPD's metering circuit breakers to minimise the length of the multicores. Access routes must be kept clear and be well lit.

Meter panels shall not be installed in the vicinity of running water (e.g. taps, basins, showers, baths etc.) and shall not be installed in bathrooms, shower rooms, saunas, steam rooms or equivalent.

Meter panels shall be segregated from gas meters and gas pipes by at least 300mm and must not be positioned where they are vulnerable to physical damage or vandalism.

Multi-core cables connecting the CTs and VT to the metering panel shall comply with EE SPEC: 80. The maximum length of multicore is limited by the rated burden of the CTs. In practice the maximum acceptable multicores length is:

- 10m where a single 2.5mm² copper core is used per phase
- 20m where two 2.5mm² copper cores are used per phase

Metering current transformers specified by WPD within **Primary Switchgear** have an accuracy class of 0.2S which provide a defined level of accuracy for current between 1% and 100% of the CT rating. Metering CT ratios shall be specified / selected that ensure, as far as possible, the actual load current remains within these accuracy limits.

A separate metering panel is installed for each circuit to be metered, each panel requires a minimum wall space of 1m x 1m x 1.5m (depth). Meters shall be mounted between 0.5m – 1.8m from the finished floor height. The wall on which Western Power Distribution's meter panel is mounted shall be suitable for fixing / supporting the weight of this equipment.

9.4 Complex Metering Arrangements

Balancing and Settlement Code (BSC) procedures allow the data from separate meters to be settled together, where appropriate.

In some circumstances a customer may wish to feed demand on one side of their installation from generation installed on the other side, through their metering (and via WPD's bus-section) as shown in Figure 23. In these circumstances, as long as the two **Connection Points** are in close proximity to each other (e.g. provided from the same switchboard) it is acceptable for the metering data to be settled as follows:

$$\begin{aligned}\text{Total Import} &= (\text{Import 1} - \text{Export 2}) + (\text{Import 1} - \text{Export 2}) \\ \text{Total Export} &= (\text{Export 1} - \text{Import 2}) + (\text{Export 2} - \text{Import 1})\end{aligned}$$

Further information on complex sites is provided BSCP514.

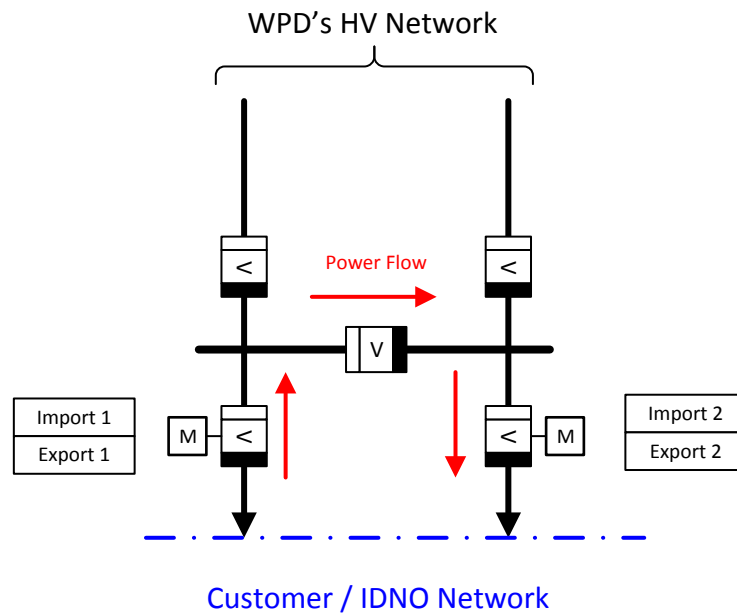


Figure 25 Complex Settlement Arrangements

9.5 Liaison with the Meter Operator

The Customer or Supplier has the right to appoint their own Meter Operator. The Customer must enter into a Meter Operator Agreement.

Metering facilities installed or modified by WPD (e.g. CTs, CT ratios, VTs, meter panels etc.) shall be commissioned and recorded in accordance with ST: TP14D. This ensures the correct information is sent to the relevant Meter Operator.

10.0 EMERGENCY TRIPPING

All HV customer connections shall be provided with a means for the customer to switch off the incoming electricity in an emergency. WPD does not provide these facilities for IDNO connections.

A typical emergency tripping system is shown in Figure 24. Where the connection has multiple Connection Points located in close proximity to each other a single trip button should be provided that disconnects all of the **Connection Points**. Where the **Connection Points** are at different locations separate trip buttons are provided.

If the customer requires an additional trip button at an alternative position they may install a trip receive panel next to the standard intertrip button, as shown in Figure 25. Where this the case, the customer is responsible for purchasing and installing all additional equipment, including the associated D.C. battery / charger system, multicores / pilots, the intertrip receive panel, trip receive relay and isolation links etc. The trip receive relay shall be a protection class relay that satisfies ENA TS 48-4.

A standard emergency trip button is shown in Figure 27. The E5 Code is 31546.

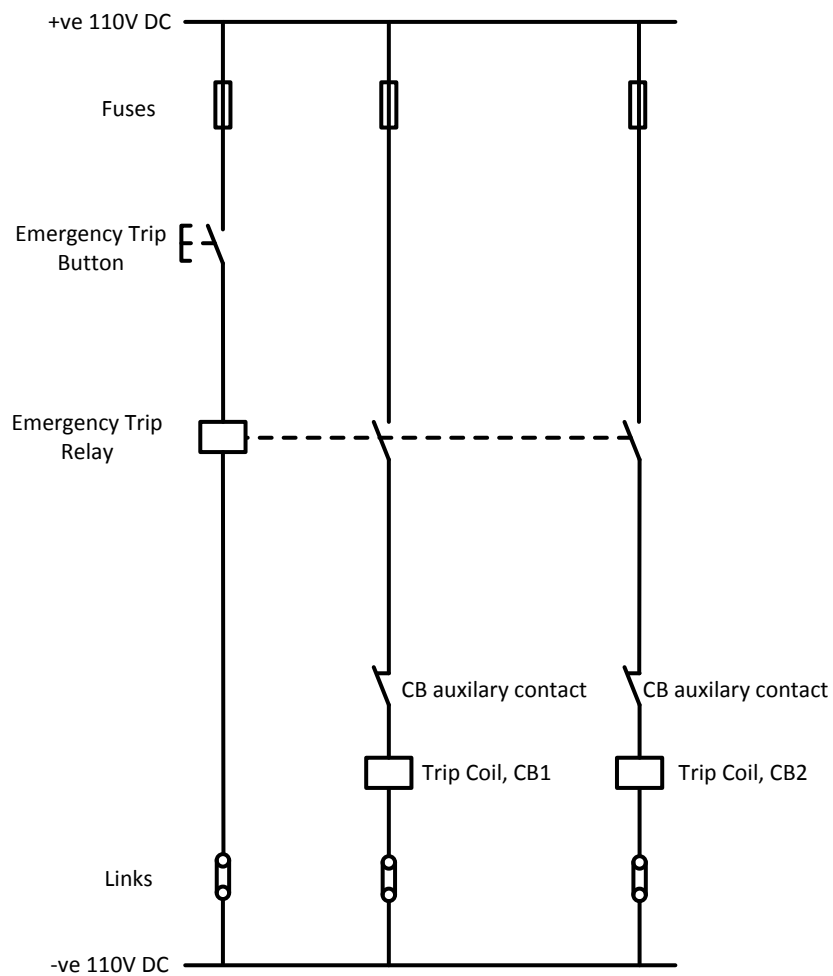


Figure 26 Typical Emergency Tripping Arrangement

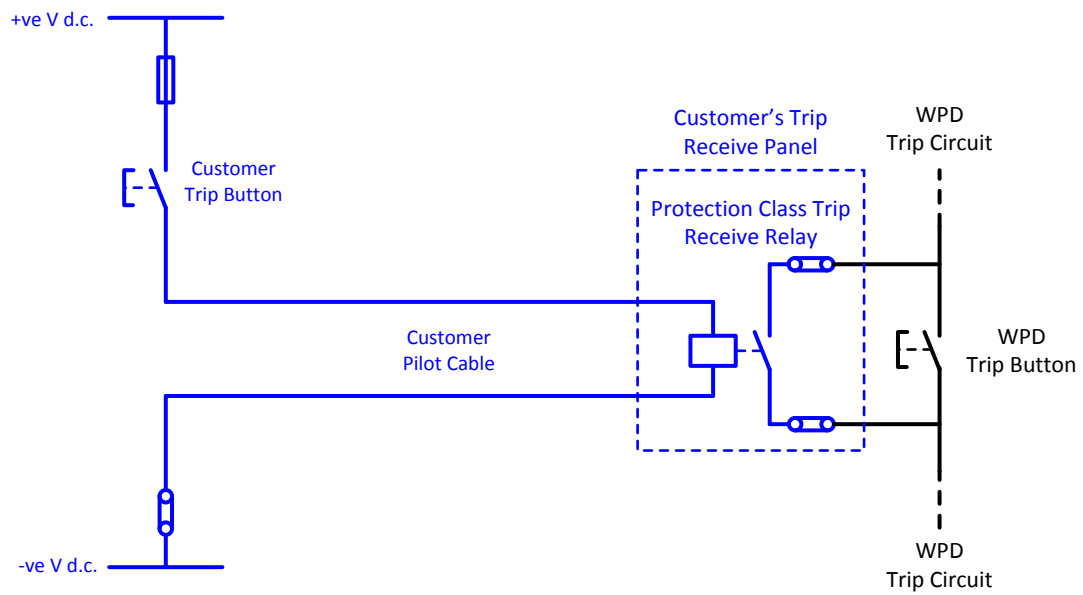


Figure 27 Emergency Tripping – Additional Customer Trip Button



Figure 28 Emergency Tripping Button

11.0 LV AC AUXILIARY SUPPLIES

11.1 General

WPD require a 230V LV AC supply for heating, lighting, sockets, and/or battery charger systems. These supplies are required 24 hours per day, 365 days per year. Where the supplies are disconnected (e.g. due to a fault) they shall be restored within 12 hours by the organisation responsible for providing the supplies, i.e. the customer, IDNO or WPD as applicable.

Where HV and LV earthing systems are segregated an isolation transformer shall be installed that maintains the required level of electrical isolation between the two earthing systems. Further guidance is provided in ST: TP21D.

Tripping, intertripping, signalling and communication circuits also require a suitable level of isolation where they bridge between sites with segregated or separate earthing systems.

11.2 Customer Connections

Unless otherwise agreed with WPD the HV customer shall provide WPD with a 230V 50Hz LV AC auxiliary rated at 80A derived from their network.

At sites with parallel generation, the LV AC supply should remain energised when generator interface protection (e.g. G59 protection) operates and disconnects the generation.

11.3 IDNO Connections

At IDNO installations the party responsible for providing the LV AC supplies to the substation shall be agreed between WPD and the IDNO. When making this decision the cost and practicality of each party providing the LV AC supplies shall be taken into consideration. The decision is likely to be based on the proximity of the DNO, IDNO and in some cases the IDNO customer's LV network to the substation.

Where the HV and LV earthing systems are segregated the LV AC supply shall be derived from a suitable customer isolation transformer that maintains the required level of isolation between the earthing systems. Further guidance is given in ST: TP21D.

At sites with parallel generation, the LV AC supply should remain energised when generator interface protection (e.g. G59 protection) operates and disconnects the generation.

12.0 BATTERY SYSTEMS

All connections that utilise **Primary Switchgear** require a 110V DC battery charger system for the switchgear tripping and protection supplies and either a 48V DC or 24V DC battery system for the tele-control facilities, depending on the substation location.

Some existing substations use 30V DC battery charger systems for tripping / protection but 110V DC systems shall be used for new switchgear.

Battery systems that are used to supply WPD's plant and equipment (e.g. switchgear, protection and/or tele-control facilities) shall be owned, operated and maintained by WPD. These systems are selected / sized in accordance with ST: TP6K and must satisfy the following specifications, as applicable:

- EE SPEC: 24 30V Battery Systems
- EE SPEC: 25 110V Battery Systems
- EE SPEC 104 24V and 48V Battery Systems

Tripping, intertripping, signalling and communication circuits also require a suitable level of isolation where they bridge between sites with segregated or separate earthing systems.

13.0 TELECONTROL FACILITIES

All WPD arrangements specified in this document shall be provided with SCADA (Supervisory Control and Data Acquisition) facilities. The requirements for RTUs (Remote Terminal Units) and the associated communication equipment (radio systems etc.) are outside of the scope of this document.

Details of the SCADA analogues, controls and status' associated with WPD's 12kV **Primary Switchgear** are provided in EE SPEC: 185, EE SPEC: 136 and the associated standard schematic drawings.

Tele-control facilities associated with **Connection Control Panels (CCPs)** are specified in POL: TP18 and the associated STs and specifications.

14.0 GENERATION CONNECTIONS

14.1 Customer Connections

Generation connected to WPD's network shall satisfy the requirements of ENA EREC G59, G83, G99 or G98, as applicable.

In addition, where the Agreed Export Capacity is greater than 500kW:

- A **Connection Control Panel (CCP)** shall be connected to each metering circuit breaker. These panels may be configured for Active Network Management (ANM), soft intertrip or voltage constraint with soft intertrip. They allow WPD to limit or control the power exported by customer generation. Further guidance is given in the TP18 series of documents.

- HV Neutral Voltage Displacement shall be provided by WPD or by the Customer to disconnect parallel generation. This requirement is mandatory for new and substantially modified connections (i.e. where new HV switchgear is installed) and for existing connections that already have an appropriate VT (i.e. a 5 limb VT or 3 single phase VTs) and a NVD relay installed.

14.2 IDNO Connections

IDNOs shall ensure generation connected to their network complies with the requirements of ENA EREC G59, G83, G99 or G98, as applicable.

Where the Agreed Export Capacity is greater than 500kW:

- WPD recommended that the customer connection is fitted with HV NVD protection.
 - Where the IDNO supplies a single HV customer and does not own / operate any HV switchgear the NVD requirements specified in clause 14.1 apply.
 - In all other cases, the IDNO shall specify the NVD requirements.
- WPD require a WPD owned and controlled **Customer Control Panel (CCP)** to be fitted at each IDNO customer connection that has an agreed export capacity of 500kW or more. Further guidance is given in the TP18 series of documents.
 - Where the IDNO supplies a single customer and does not own any HV switchgear the **CCP** is connected to WPD's HV switchgear. In this case the **CCP** and the associated communication equipment is provided by WPD and is chargeable as part of the connection costs.
 - In all other cases, where the **CCP** is connected to the IDNO's HV switchgear the **CCP** and the associated communication equipment (e.g. Remote Terminal Unit, radio, aerial etc.) is provided by WPD free of charge. In this case the installation is carried out by the IDNO at their cost (including any additional switchgear and cabling costs etc.).

15.0 MULTIPLE CONNECTIONS TO A SINGLE SITE

15.1 Multiple Customer Connections

WPD provide a single point of connection to each HV customer site as standard, however, in some cases the customer may require more than one connection, for example, where:

- enhanced security is required
- the site is large and fragmented and there is no electrical interconnection between separate parts of the site

- additional capacity is required

Where multiple connections are provided this introduces a number of challenges, including:

- Risk of paralleling through the customer's network
- Complex earthing / bonding issues
- Additional operational complexity (e.g. means of electrically isolating the site under emergency conditions or when work is carried out)
- Additional metering complexity

(a) Risk of Paralleling:

WPD normally operates radial HV circuits which can be reconfigured by carrying out short term parallels (in order to move normal open points). HV customers fed from radial circuits are not normally allowed to parallel WPD's network through their system due to the risk of high paralleling currents, protection mal-operation and meter settlement issues.

In order to prevent the customer's network from being paralleled one or more of the following precautions shall be applied:

- The customer's network supplied from each **Connection Point** shall be physically segregated so that interconnection is impossible.
- The customer fits interlocking to prevent paralleling. This interlocking either consists of mechanical interlocking and/or fail-safe electrical (hard wired) interlocking. Software interlocking provided by programmable logic controllers (PLCs) or equivalent is not acceptable.
- WPD's network is operated with one of the metering circuit breakers as a normal open point.

Where WPD's incoming circuits are designed to operate in parallel it may be acceptable for the customer to operate their circuits in parallel as well. Where this is proposed Primary System Design (PSD) shall assess that the customer's proposed protection systems and only allow paralleling if they are acceptable.

(b) Complex Earthing / Bonding:

Where multiple connections are provided the earthing systems of each connection may be derived from different earth electrodes / earthing systems. This could cause differences in potential between items of equipment connected / bonded to different connections if precautions are not taken. Precautions could include:

- Ensuring metalwork and items of equipment that are connected / bonded to the earth terminal of the different connections are physically separated from each other (by at least 2.5m) to prevent anyone touching both items of equipment at the same time. Where this approach is used any item of equipment that could possibly transfer the potential from one earth zone to another must be removed / isolated (e.g. pipes, wiring, fences, communication cables etc.)
- Ensure the earthing systems associated with each connection are common (i.e. physically bonded together). Note, WPD's 11kV and 6.6kV cable screens are bonded to the HV earth electrode at each substation / switchroom which helps to prevent differences in potential between at different sites. Despite this, differences in potential may still occur.

Any such bonding must be rated for the current that flows through it. Anyone working on the bonding (e.g. installing, extending, disconnecting or replacing the bonding) must take precautions to mitigate the electrocution risks.

Multiple connections provided at different voltages (e.g. one connection provided at 11kV and one at LV) should be avoided, as far as practicable. Where this cannot be avoided precautions shall be taken to prevent earth potential rise caused by faults on the high voltage network from causing danger in the low voltage system. The simplest way of achieving this is to physically segregate the buildings / metalwork / equipment supplied by each connection.

Further guidance on LV, 11kV and 6.6kV earthing is included in ST: TP21D.

(c) Operational Complexity

Where multiple connections are provided, the means of disconnecting and isolating the customer's network (e.g. under emergency conditions or to enable work to be carried out on his/her electrical network) may be more complex than normal. It is essential that appropriate schematic drawings and labels / notices are provided at each **Connection Point** that clearly state (i) that more than one **Connection Point** is provided, and (ii) describe where the other points of disconnection / isolation are located.

It is not acceptable for multiple connections to be provided to a site by different DNOs or IDNOs. The only possible exception is where the site is split into separate geographical areas / buildings that are electrically and physically segregated from each other.

Where the Customer wishes to install an automatic changeover facility (at HV or at LV) that automatically switches all, or part of their network from one incoming connection to another (e.g. following a supply failure) a "break before make" system shall be used. In other words the backup connection shall only be capable of being switched in (closed) after the normal connection has been disconnected (opened).

Automatic changeover systems shall either utilise a break before make changeover switch (i.e. where the main contacts in the switch physically break one connection before they connect to the other connection) or comprise two switches that have a failsafe electrical (i.e. hard wired) control / interlocking system that prevents the back-up switch from being closed until the first switch has opened. Software interlocking systems are not acceptable.

Automatic changeover systems shall be designed to prevent faults on the customer's system from being re-energised automatically more than once.

If generation is installed that is capable of operating in parallel with WPD's system, its operation may need to be restricted to only allow it to run when connected to one of the connections. Where this is the case, the interlocking shall be designed to prevent parallel operation with the other connections. Any such restrictions shall be detailed in the Connection Agreement.


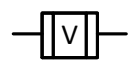




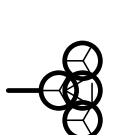
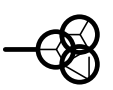

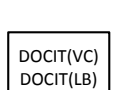



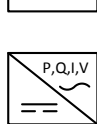
15.2 Multiple IDNO Connections

Western Power Distribution normally provide a single connection to each IDNO Network unless otherwise required for network security reasons.

Where multiple connections are provided the DNO may only parallel between these connections (through their HV Network) with reference to, and with the agreement of, WPD's Control Centre. Any parallel through the DNO's HV network shall only be maintained for a short period of time (as agreed with WPD's Control Centre) to allow open points to be moved.

The IDNO shall not, under any circumstances, parallel, or back feed WPD's HV network through their LV network, or through a customer owned LV network.

KEY TO DRAWINGS

	Vacuum Circuit Breaker with Protection
	Vacuum Circuit Breaker without Protection
	Meter Panel
	Normal Open Point
	Transformer
	Current Transformer
	Voltage Transformer (star/star/star/open-delta)
	Voltage Transformer (star/star/open-delta)
	IDMT Overcurrent and Earth Fault Protection
	IDMT Voltage Controlled Directional Overcurrent protection and IDMT Load Blinded Directional Overcurrent Protection
	IDMT Directional Overcurrent and Earth Fault Protection
	Neutral Voltage Displacement Protection
	Pilot Wire or Current Differential (unit) Protection
	Transducer: Active Power (P), Reactive Power (S), Current (I) and Voltage (V)

Equipment coloured **black** is WPD owned

Equipment coloured **blue** is customer or IDNO owned

APPENDIX B

SUPERSEDED DOCUMENTATION

This document supersedes ST:SD4O/2 Part 2 dated October 2018 which has now been withdrawn.

APPENDIX C

ANCILLARY DOCUMENTATION

Electricity Safety, Quality and Continuity Regulations

Electricity at Work Regulations

ENA EREC G59, Recommendations for the connection of generating plant to the distribution systems of Licensed Distribution Network Operators.

ENA EREC G99, Recommendations for the connection of generating equipment in parallel with public distribution networks on or after 27th April 2019.

ENA EREC G83, Recommendations for the connection of type tested small scale embedded generators (up to 16A per phase) in parallel with low-voltage distribution networks.

ENA EREC G98, Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks on or after 27 April 2019.

ST: SD4A, Design of Western Power Distribution's 11kV and 6.6kV Networks

ST: TP21D, 11kV, 6.6kV and LV Earthing

EE SPEC: 89, Fixed Earthing Systems for Major Substations

EE SPEC: 185, 12kV Indoor Circuit Breakers

EE: SPEC: 98, Approved Protection, Voltage Control and Alarm Relays and Test Access Blocks

EE: SPEC 136, Ancillary Electrical Equipment for Use in Conjunction with Switchgear and Protection/Control Panels

APPENDIX D

KEY WORDS

Standard HV Arrangements, HV Connection, Emergency Tripping, Generation.