

## Company Directive

### STANDARD TECHNIQUE: SD40A/1

## 11kV and 6.6kV Connections to Customers and IDNOs Secondary Type Switchgear Arrangements

#### Policy Summary

This document specifies the requirements for HV connections to Customers and IDNOs using secondary switchgear

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**Implementation Date:** March 2023

**Approved by**



**Carl Ketley-Lowe**  
Engineering Policy Manager

**Date:** 27<sup>th</sup> March 2023

<b>Target Staff Group</b>	Staff involved in the design, installation, operation and maintenance of National Grid Electricity Distribution's (NGED's) 11kV and 6.6kV networks
<b>Impact of Change</b>	Amber – the changes affect the possible design of customer connections
<b>Planned Assurance checks</b>	None – the changes are to align with the provision of Curtailable Connections noted by Connections Strategy

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## IMPLEMENTATION PLAN

### Introduction

This document, ST: SD4OA/1, specifies the requirements for HV connections to Customers and IDNOs using secondary switchgear.

### Main Changes

Rebranded document and updated to signpost 'Curtailed Connections' and 'Flexible Connections'.

### Impact of Changes

<b>Target Staff Group</b>	<b>Staff involved in the design, installation, operation and maintenance of National Grid Electricity Distribution's 11kV and 6.6kV networks</b>
<b>Impact of Change</b>	<b>Amber – The changes affect the design of connections to National Grid Electricity Distribution's 11kV and 6.6kV networks</b>

### 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

<b>Document Revision &amp; Review Table</b>		
<b>Date</b>	<b>Comments</b>	<b>Author</b>
March 2023	Document rebranded and clauses 3.1.3, 3.2.2, 3.3.5 added to signpost 'Curtailed' and 'Flexible' Connections	Seth Treasure
April 2019	Document number has changed from ST: SD4O/2 Part 1 to ST: SD4OA	Andy Hood
October 2018	<p>The previous version of ST: SD4O has been completely re-written and split into two documents. This document includes the following significant changes:</p> <ul style="list-style-type: none"> <li>• Requirements for primary switchgear have been removed</li> <li>• Requirements for IDNO connections have been added</li> <li>• Arrangements based on secondary extensible switchgear have been removed</li> <li>• Arrangement 2B, 2C, 2D and 2E have been added</li> <li>• Information on complex metering arrangements has been added</li> <li>• Emergency tripping requirements have been updated</li> <li>• A section on LV AC supplies has been added</li> <li>• Requirements for generator connections have been updated, including requirements for NVD protection</li> <li>• Additional information on multiple connections has been included.</li> </ul>	Andy Hood

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## 1.0 INTRODUCTION

- 1.1 This document specifies the requirements for 11kV and 6.6kV connections to customers and IDNOs using **Secondary Switchgear**. It should be read in conjunction with ST: SD4A (HV Network Design) and ST: SD4OB (11kV and 6.6kV Connections to Customers and IDNOs using **Primary Switchgear**).
- 1.2 Where any difficulty is encountered in applying this document the author shall be contacted who will determine if a variation is appropriate.

## 2.0 DEFINITIONS

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

**Connection Point:** The point at which a customer, DNO or IDNO connects to National Grid Electricity Distribution's (NGED's) distribution system.

**Curtailed Connection:** Means a connection to the NGED distribution system which is made on the basis that it is expressly subject to a reduction in capacity during certain network configurations or due to network availability (due to outages or where thermal or voltage limits are reached) and where the connection offer was made on or after 1<sup>st</sup> April 2023. Active Network Management is considered to be a Curtailed Connection.

**Flexible Connection:** Means a connection to the NGED distribution system which is made on the basis that it is expressly subject to a reduction or restriction in capacity. A Timed connection or a connection incorporating a customer owned limitation scheme would be deemed to be a Flexible Connection.

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

**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.

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

Secondary switchgear arrangements are relatively simple and cost effective but have limited protection and tele-control facilities.

Three secondary switchgear arrangements are available, each of which has a number of variations to accommodate different loads and network security requirements:

- Arrangement 1: Single Non-extensible Circuit Breaker
- Arrangement 2: Single Non-extensible Ring Main Unit (RMU)
- Arrangement 3: Two Non-extensible Ring Main Units

### 3.1 **Arrangement 1: Single Non-extensible NGED Owned Circuit breaker**

3.1.1 Arrangement 1 is a teed connection that is only suitable for connection to an IDNO close coupled transformer. The continuous rating of the switchgear is 200A. HV metered and cable connected options are not available since the earth switch on the customer / IDNO side of the circuit breaker is not fully rated. For customer connections and for other IDNO connections Arrangement 2 or 3 shall be used instead.

3.1.2 No provision is made for a Customer Connection Panel (CCP) or for Neutral Voltage Displacement (NVD) protection and therefore this arrangement is not applicable where the connections with an Agreed Export Capacity above 500kW or where a 'Curtailed Connection' or 'Flexible Connection' is desired.

#### 3.1.3 Flexible Connections

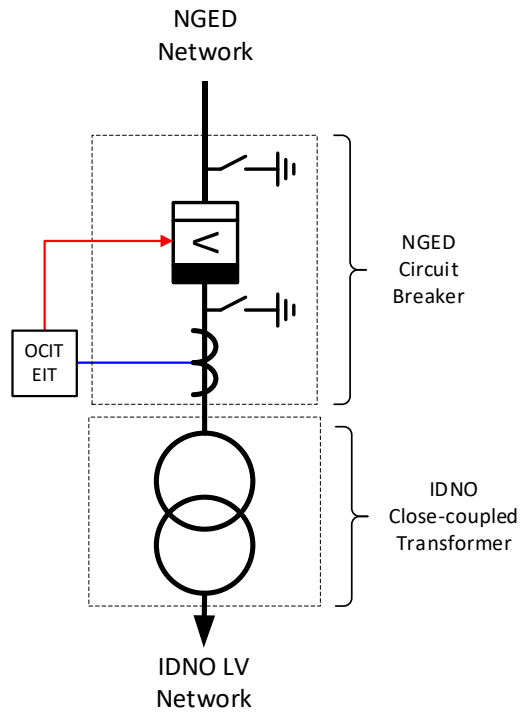
A Flexible Connection may be provided with the use of Arrangement 1A e.g. a Timed Connection or connection that incorporates a customer owned limitation scheme to maintain the import or export of current/power to that of the Agreed Supply Capacity. Metering unit MU2DN47 - 200A, commodity code 61752.

**Table 1 Summary of Options for Arrangement 1 (Single Non-extensible NGED Owned Circuit Breaker)**

Arrangement No and Description	Customer or IDNO Connection	Maximum Load	Circuit Breaker Rating	Protection CTs	Protection Type	Metering CT options	Emergency Tripping
Arrangement 1 CB close coupled to an IDNO Transformer	IDNO	200A	200A	50/100/5	TLFs <sup>[1]</sup>	N/A	N/A
				200/1	Self Powered O/C and E/F Relay		


Notes:

[1] TLFs (time limit fuses) may be used to protect a single IDNO owned transformer rated up to 1500kVA; for larger transformer sizes a self-powered protection relay shall be used.



Arrangement 1A

**Key:**

TLFs or Self Powered Relay = 

CTs = 

**Notes:**

The earth switch on the IDNO side is only rated at 3.15kA and therefore this option may only be used with a close coupled IDNO transformer. Arrangement 2A, 2B, 2C or 2D are used where the switchgear is not closed coupled with a transformer.

TLFs may only be provided where they are used to protect a close coupled IDNO owned transformer rated up to 1500kVA. In all other cases a self powered protection relay shall be provided.

**Figure 1: Arrangement 1A Non-extensible Circuit Breaker Connection**



## 3.2 Arrangement 2: Single Non-extensible NGED Owned Ring Main Unit (RMU)

3.2.1 This arrangement is suitable for loads up to 400A. Five options are described below, and shown in Figure 2 and Figure 3:

- Arrangement 2A utilises a single NGED owned non-extensible RMU. The tee off circuit breaker is close-coupled to a NGED owned or IDNO metering unit. The HV customer connects via the cable box on the metering unit.
- Arrangement 2B is similar to 2A but in this case a CCP is provided as well.
- Arrangement 2C is similar to 2B but in this case a D.C. powered protection relay is provided with NVD protection (instead of a self-powered relay). Further guidance on the provision of NVD is given in Section 13.
- Arrangement 2D utilises a single NGED owned non-extensible RMU close coupled to an IDNO transformer. There is no provision for a CCP or for NVD protection since the customer connections are at LV.
- Arrangement 2E utilises a single NGED owned non-extensible RMU with a cable box fitted to the tee off circuit breaker. This arrangement is used to connect to an IDNO HV cable. There is no provision for a CCP or for NVD protection since the IDNO is expected to provide these facilities on their HV switchgear, where required.

### 3.2.2 Curtailable or Flexible Connections

- A Flexible Connection may be provided with the use of Arrangement 2A, 2D or 2E e.g. a Timed Connection or connection that incorporates a customer owned limitation scheme to maintain the import or export of current/power to that of the Agreed Supply Capacity. For Arrangement 2A only, metering unit MU2DN47 - 200A, commodity code 61752 or MU6DN45 - 400A, commodity code 62943.
- A Curtailable Connection may be provided with the use of Arrangement 2B for a demand connection of up to 7.6MVA (11kV) where the Export capacity does not exceed 500kVA. Metering unit MU2DN48 - 200A, commodity code 61756 or MU6DN46 - 400A, commodity code 62942.
- A Curtailable Connection may be provided with the use of Arrangement 2C for a demand or generation connection of up to 7.6MVA (11kV). Metering unit MU2DN48 - 200A, commodity code 61756 or MU6DN46 - 400A, commodity code 62942.
- For further guidance on the provision of Curtailable Connections, see POL: SD11 and the associated Standard Techniques. A guide can also be found via the following [link](#).
- For further guidance on the provision of Flexible Connections, see POL: FD3 and the associated Standard Techniques.

**Table 2 Summary of Options for Arrangement 2 (Single Non-extensible NGED Owned RMU)**

Arrangement No and Description	Customer or IDNO Connection	Maximum Load	Circuit Breaker Rating	Protection CTs	Protection Type	Metering CT options	Emergency Tripping
<u>Arrangement 2A</u> NGED RMU close coupled to NGED or IDNO Metering Unit	Customer or IDNO	200A	200A	200/1	Self Powered O/C and E/F Relay	100/50/5 or 200/100/5 <sup>[1]</sup>	For customer connections only <sup>[3]</sup>
		400A	630A	800/1		400/200/5 <sup>[1]</sup>	
<u>Arrangement 2B</u> NGED RMU close coupled to a NGED or IDNO metering unit with an CCP	Customer or IDNO	200A	200A	200/1	Self Powered O/C and E/F Relay	200/100/5 <sup>[1][2]</sup>	For customer connections only <sup>[3]</sup>
		400A	630A	800/1		400/200/5 <sup>[1][2]</sup>	
<u>Arrangement 2C</u> NGED RMU close coupled to a NGED or IDNO metering unit with NVD protection & CCP	Customer or IDNO	200A	200A	200/1	DC Powered O/C, E/F and NVD Relay	200/100/5 <sup>[1][2]</sup>	For customer connections only <sup>[3]</sup>
		400A	630A	800/1		400/200/5 <sup>[1][2]</sup>	
<u>Arrangement 2D</u> NGED RMU close coupled to an IDNO transformer	IDNO	200A	200A	50/100/5	TLFs <sup>[4]</sup>	N/A	N/A
		200A	200A	200/1	Self Powered O/C and E/F Relay		
		400A	630A	800/1			

**Table 2 Summary of Options for Arrangement 2 (Single Non-extensible NGED Owned RMU), continued**

Arrangement No and Description	Customer or IDNO Connection	Maximum Load	Circuit Breaker Rating	Protection CTs	Protection Type	Metering CT options	Emergency Tripping
Arrangement 2E NGED RMU connected to IDNO HV Cable	IDNO	200A	200A	50/100/5	TLFs <sup>[4]</sup>	N/A	N/A
		200A	200A	200/1	Self Powered O/C and E/F Relay		
		400A	630A	800/1			

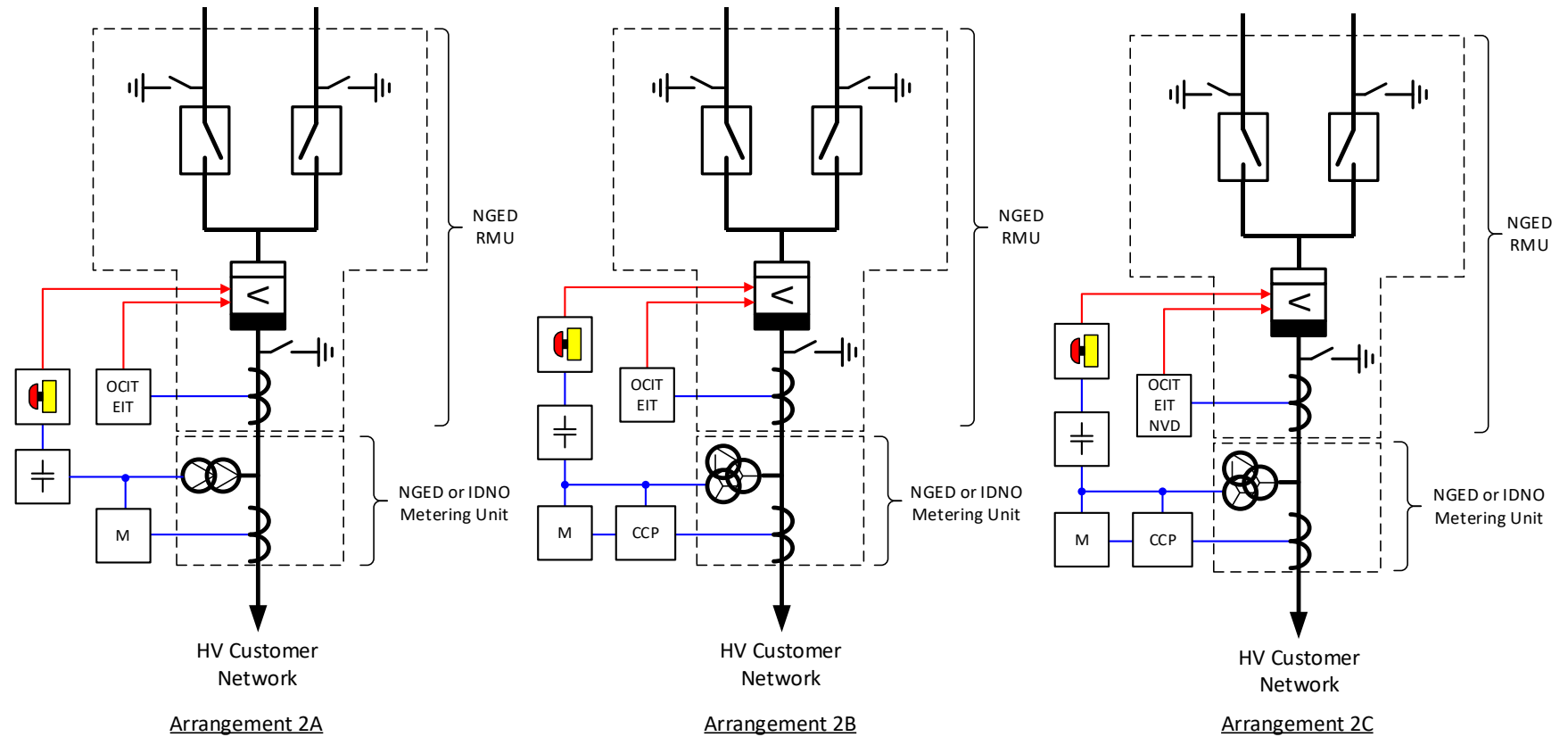
Notes:

[1] Metering CT ratios only apply to NGED metering units only.

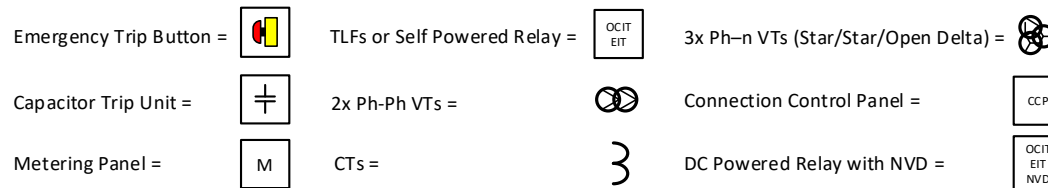
[2] Where a CCP is required the metering unit must include additional fuses, links and secondary terminals for the additional VT connections.

[3] NGED only provide emergency tripping facilities for customer connections. If an IDNO provides emergency tripping facilities for their HV customer NGED will allow this to trip the NGED circuit breaker, if a shunt trip coil is fitted and it is compatible with the IDNO's trip supply.

[4] TLFs (time limit fuses) may only be used to protect a single IDNO owned transformer rated up to 1500kVA. For all other arrangements a self-powered protection relay shall be used.



**Key:**

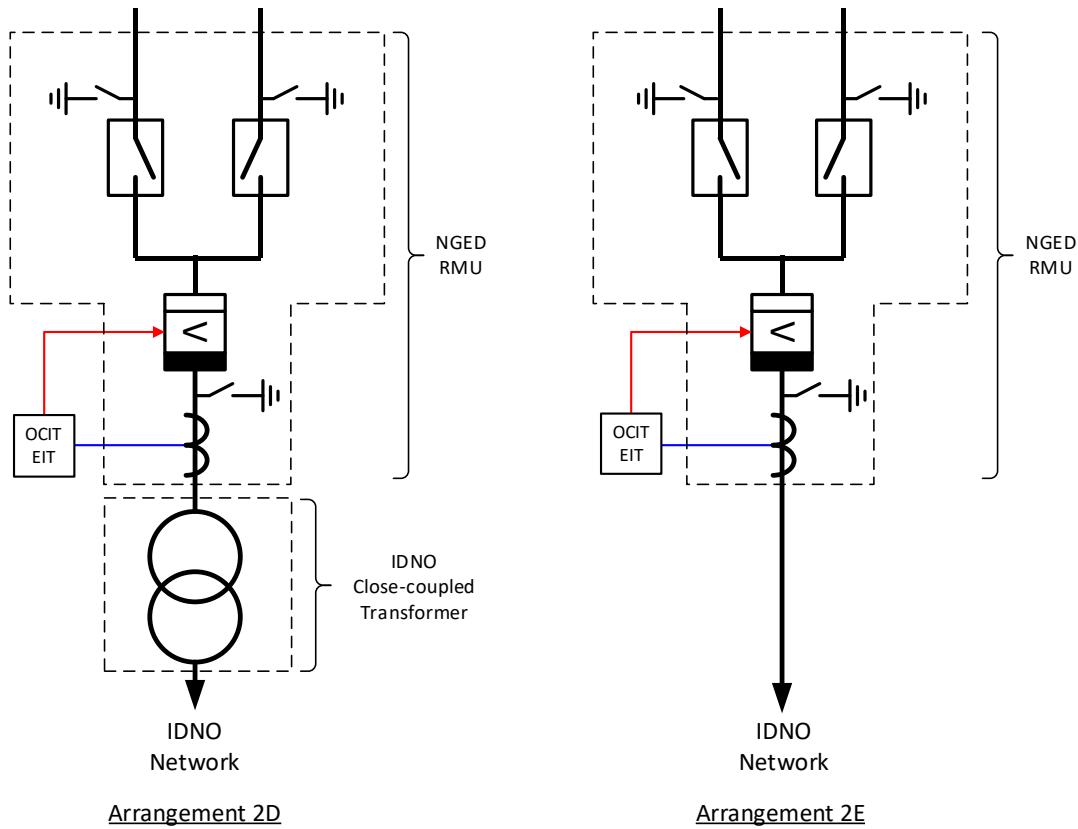


**Notes:**

A self powered protection relay is required for Arrangements 2A and 2B, and a DC powered relay for Arrangement 2C.

NGED only provide emergency tripping facilities for NGED HV customer connections. Where an IDNO provides emergency tripping facilities for their HV customer these may trip NGED's circuit breaker as long as a shunt trip coil is fitted and this is compatible with the trip supply.

**Figure 2 Arrangements 2A, 2B and 2C, Single RMU Connection via a Metering Unit**



**Key:**

TLFs or Self Powered Relay =



CTs =



**Note:**

TLFs may only be provided where they only protect one IDNO owned transformer rated up to 1500kVA. In all other cases a self powered protection relay shall be provided.

**Figure 3 Arrangements 2D and 2E, Single RMU Connection to a Close Coupled IDNO Transformer or IDNO Cable**

### 3.3 Arrangement 3, Two Interconnected NGED Ring Main Units

3.3.1 Arrangement 3 is applicable where the customer or IDNO requires additional security or, in some circumstances, additional load (demand or generation). The maximum load connected to each metering circuit breaker is 400A. The combined load is limited by the network rating and by security considerations (i.e. ENA EREC P2, etc.).

3.3.2 Where two RMUs provide insufficient capacity or inadequate security a primary switchgear arrangement shall be offered instead. It is not acceptable to use more than one pair of RMUs to supply a single site unless each pair of RMUs supplies different buildings or different parts of the site that are physically and electrically segregated / separated from each other. Guidance on multiple connections is provided in Section 13. ST: SD4OB provides information on primary switchgear arrangements.

#### 3.3.3 Customer Connections:

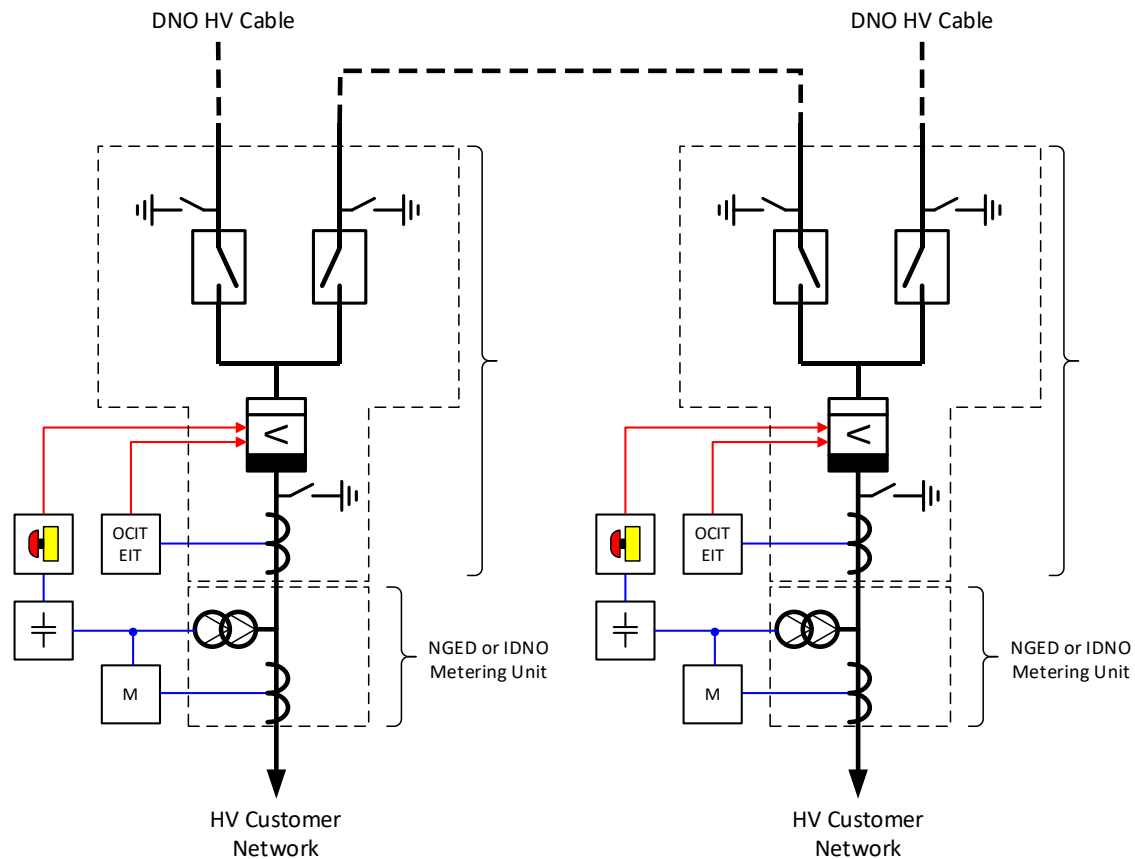
- Each individual RMU connection shall be in accordance with option 2A, 2B or 2C as applicable. The only difference is that two RMUs are installed within 10m of each other and interconnected, as shown in Figure 4.
- Open points shall be selected so that the two RMUs are connected to the same HV circuit when fed normally. This ensures the point of common coupling for the two connections is electrically close to both sets of metering. This allows the two sets of metering to be settled together (if required) and minimises any paralleling current should the customer inadvertently parallels through their network.
- Tele-control facilities and where necessary Power on Fusion (PoF) automatic restoration schemes may be provided to improve security, if requested by the customer. Further guidance on PoF automatic restoration is available from the Operations Support Teams.
- Further requirements / restrictions for multiple connections are detailed in Section 14.

#### 3.3.4 HV IDNO Connections:

- Each individual RMU connection shall be in accordance with option 2A, 2B, 2C, 2D or 2E, as applicable. The only difference is that two RMUs are installed and interconnected, as shown in Figure 4 and Figure 5.
- Where both RMUs supply a single HV customer the requirements of 3.3.3. also apply. The IDNO shall ensure the customer does not parallel their network across the two connections.
- Where the two RMUs supply more than one IDNO customer they may be connected to different HV circuits.
- Further requirements / restrictions for multiple connections are detailed in Section 13.

### 3.3.5 Curtailable or Flexible Connections:

- The arrangements will align with the principles detailed within clause 3.2.2 above.
- Where a Curtailable Connection is being provided, a CCP shall be installed on each of the Connection Points.
- Where a customer's connection can be configured so that the aggregate demand or generation can flow via one of the provided RMUs. The individual Arrangement shall comply with the document in full e.g. where the export of power can exceed 500kVA on either of the connections an Arrangement 2C is required for both connections.



**Key:**

- |                         |  |                      |  |
|-------------------------|--|----------------------|--|
| Emergency Trip Button = |  | Self Powered Relay = |  |
| Capacitor Trip Unit =   |  | 2x Ph-Ph VTs =       |  |
| Metering Panel =        |  | CTs =                |  |

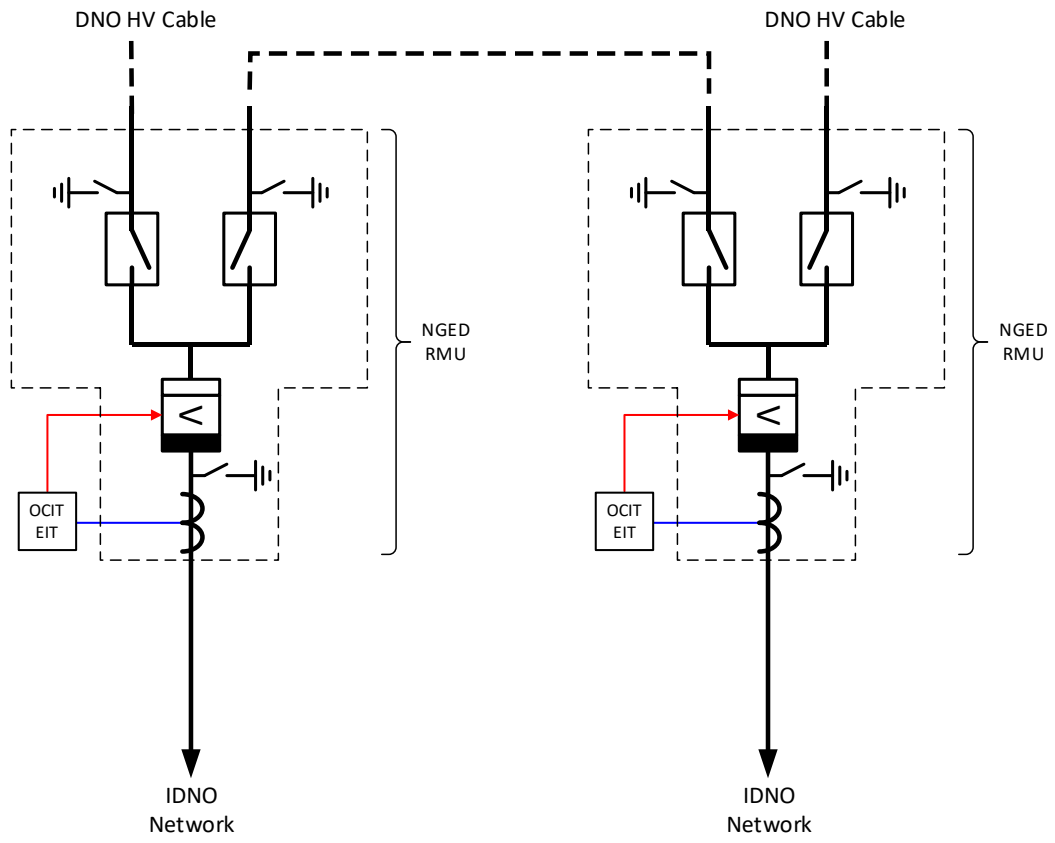
**Notes:**

The two connections must not be paralleled through the customer's network. Where interconnection is physically possible the customer shall prevent this by fitting appropriate mechanical or electrical interlocking. Software interlocking is not acceptable.



NGED only provide emergency tripping facilities for NGED HV customer connections. Where an IDNO provides emergency tripping facilities for their HV customer these may trip NGED's circuit breaker as long as a shunt trip coil is fitted and this is compatible with the trip supply.

**Figure 4 Arrangement 3 – Two RMU Connections to a Single HV Customer**





**Key:**

- TLFs or Self Powered Relay = 
- CTs = 

**Notes:**

- The specific details for each connection shall be in accordance with Arrangement 2D or 2E.
- The two connections may only be paralleled through the IDNO network for short periods when re-configuring the network. Any such switching may only be carried out with reference to, and with agreement of, NGED's Control Centre.
- The two NGED connections shall not be paralleled through customer networks. Where this is physically possible the IDNO shall ensure their customer/s fit appropriate interlocking to prevent this.

**Figure 5 Arrangement 3 – Two RMU Connections to an IDNO**

## 4.0 SUBSTATION LOCATION

4.1 The switch room / enclosure containing NGEDs switchgear, including the metering circuit breaker, 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 8 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.

4.2 For HV customer connections NGED's metering circuit breaker shall be located:

- Within 20m of the metering room and meter panel/s subject to satisfying the requirement of clause 8.5.
- 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 NGED's protection and switchgear.

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

4.4 New customer buildings or extensions constructed after NGEDs substation / switchroom has been established shall not encroach within the minimum separation distances defined in 4.1 defined above.

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

4.6 The location shall be assessed for risk of flooding from Rivers, Sea (Tidal), ground saturation (rain) and drainage capacity. NGED's mapping systems provides information regarding flood risk areas and probability. Any works within flood zones shall comply with POL SP9.

4.7 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.

4.8 Where NGED's plant or equipment switchgear is installed within a customer building this shall comply with the Buildings Regulations and with BS9999 (Fire Safety in the Design, Management and Use of Buildings – Code of Practice).

## **5.0 SUBSTATION ACCOMMODATION**

- 5.1 NGEDs plant and equipment shall be accommodated within an appropriate building or enclosure designed and 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.
- 5.2 Requirements for plinths, enclosures and buildings associated with secondary switchgear are included in ST: NC1V.

## **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 NGED 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 NGED equipment and customer / IDNO equipment
- Protection panels and interface cabinets
- LV auxiliary supplies
- Buildings / enclosures

## **7.0 LEGAL REQUIREMENTS**

- 7.1 Substations, cables and operational access areas shall have suitable land rights in accordance with the Current Estates and Wayleaves suite of documents.

## **8.0 EARTHING**

- 8.1 Detailed earthing requirements are specified in ST: TP21D. Further guidance may also be sought from the earthing specialists within Primary System Design.
- 8.2 The HV earth electrode associated with NGEDs switchgear shall be owned and maintained by NGED. NGED'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.
- 8.3 Where NGED's HV equipment and the customer's / IDNO's HV equipment is installed in close proximity of each other (e.g. within 10 meters) the HV earthing systems should be bonded directly together using copper conductor with a minimum cross-section of 35mm<sup>2</sup>. This helps to reduce the resistance of the overall HV earthing system and helps to minimise any differences in potential between NGED and customer / IDNO equipment.
- 8.4 Where NGED's HV equipment and that of the customer / IDNO is not installed in close proximity to each other direct bonding between the two HV earthing systems is not normally provided. Despite this the HV electrodes are normally connected together indirectly via HV cable screens.
- 8.5 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.
- 8.6 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. This 9m segregation distance may need to be extended in some situations.

## **9.0 SETTLEMENT METERING AT NGED CUSTOMER CONNECTIONS**

- 9.1 All NGED customer connections shall be provided with metering facilities that satisfy ST: TP14C and in particular, the section relating to *circuits with a rated capacity exceeding 1MVA but not exceeding 10MVA*.
- 9.2 NGED's distribution business owns, operates and maintains the:
- metering CTs and VTs,
  - HV metering unit,
  - HV switchgear,
  - Multicore cables between the NGED equipment and the metering panel,
  - Fuses, links and terminals within the metering unit etc.,
  - Multicore termination blocks, safe access terminal blocks (SATBs) and associated isolation fuses and links,

- Cubicle which contains the multicore termination blocks, SATB and isolation fuses and links. This is normally the meter panel itself.
- 9.3 The Supplier and appointed Meter Operator responsible for providing and maintaining the:
- Meters,
  - Meter control equipment,
  - Any additional test terminal blocks
  - Any fuses and links on the meter panel beyond NGED's isolation facilities,
  - Communication equipment, if required.
- 9.4 The meter panel and associated isolation facilities shall be installed within a room or enclosure that is separate, but in close proximity to NGED's switch room / substation. The meter room / enclosure shall be easily accessible without the need to enter NGED's switch room / substation. Access routes must be kept clear and be well lit.
- 9.5 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 2.5mm<sup>2</sup> copper core is used per phase.
  - 20m where two 2.5mm<sup>2</sup> copper cores are used per phase
- 9.6 Metering current transformers specified by NGED have an accuracy class of 0.5S which provide a defined level of accuracy for current between 1% and 100% of the CT rating. Metering CT ratios shall be specified / selected to ensure the actual load current remains between 1% and 100% of the CT ratio, so far as is practicable.
- 9.7 A separate metering panel is installed for each circuit to be metered, each panel requires 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 National Grid Electricity Distribution's meter panel is mounted shall be suitable for fixing / supporting the weight of this equipment.
- 9.8 Meter panels shall be installed within an appropriate weatherproof 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 must be no significant heat sources in the vicinity that could overheat the equipment.
- 9.9 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.
- 9.10 Meter panels shall be segregated from gas meters and gas pipes by at least 300mm and must not be where they are vulnerable to physical damage or vandalism.

## 9.11 Complex Metering Arrangements

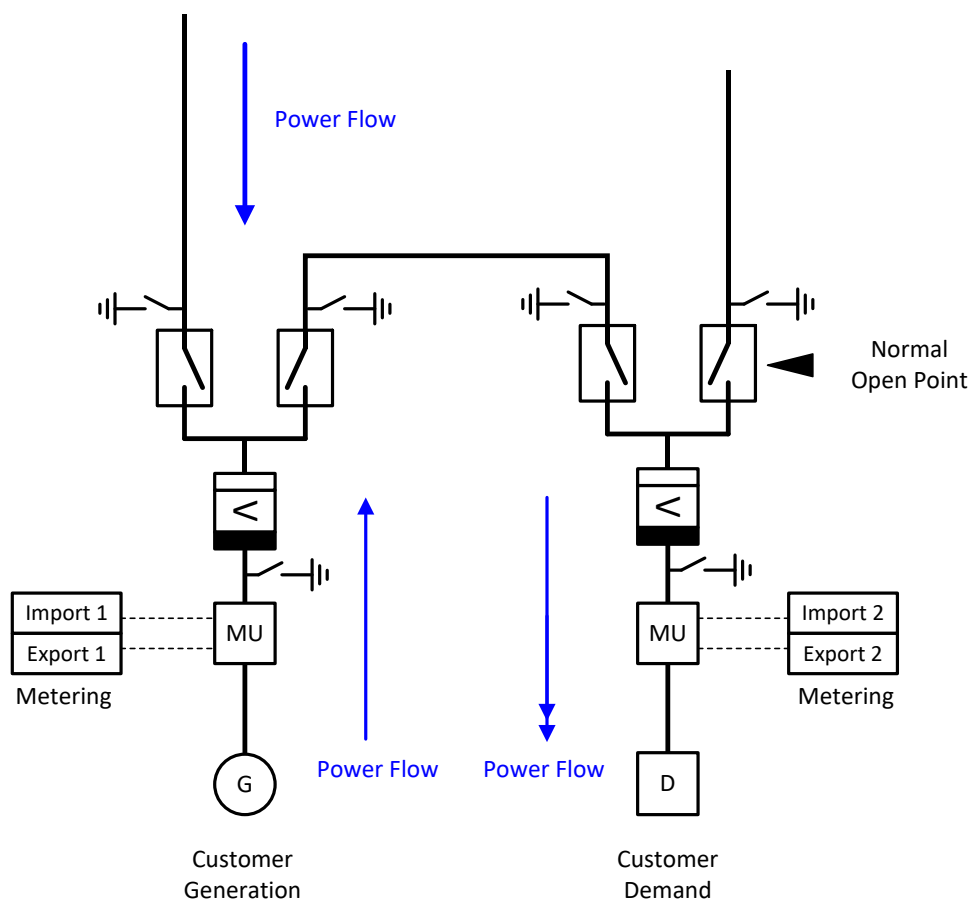
9.11.1 Balancing and Settlement Code (BSC) procedures allow the data from separate meters to be settled together, where appropriate. This approach could be used with Arrangement 3, for example.

9.11.2 In some circumstances it may be necessary to import active and/or reactive power through one connection and export it through another at the same time, as shown in Figure 6. Further information on complex sites is provided BSCP514.

## 9.12 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 NGED (e.g. CTs, 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.

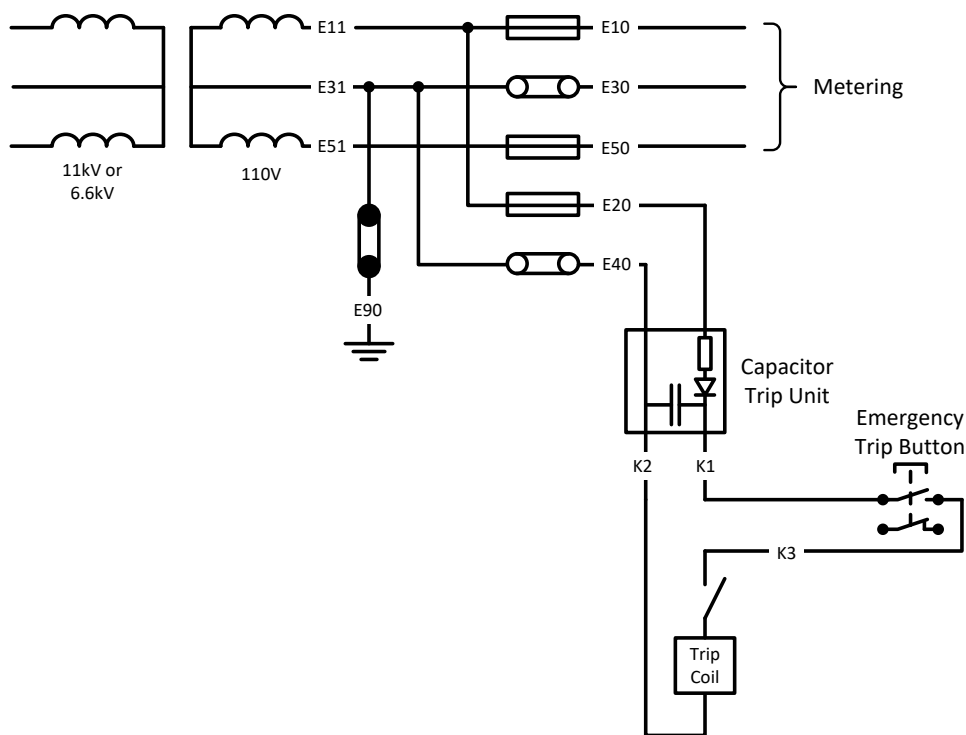


- $\text{Import} = \text{Import 1} - \text{Export 2} + \text{Import 2} - \text{Export 1}$
- $\text{Export} = \text{Export 1} - \text{Import 2} + \text{Export 2} - \text{Import 1}$

**Figure 6 Complex Settlement Arrangements**

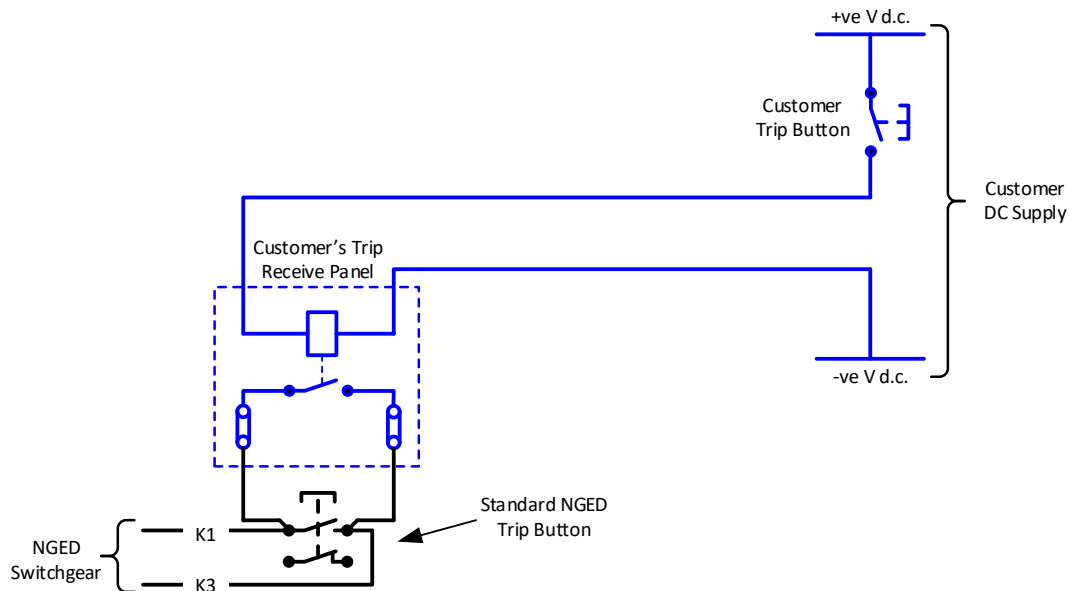
## 10.0 TRIPPING FACILITIES

- 10.1 All NGED customer connections shall be provided with a means for the customer to switch off the incoming electricity. NGED do not provide such facilities for IDNO connections.
- 10.2 Where NGED's switchgear is close coupled to an IDNO metering unit (i.e. the connection supplies an IDNO's HV customer) and the IDNO wishes to install emergency tripping facilities for their HV customer, these facilities may trip NGED's circuit breaker as long as a shunt trip coil is fitted to the switchgear that is compatible with the IDNO's tripping supply.
- 10.3 National Grid Electricity Distribution's emergency tripping system is shown schematically in Figure 5. NGED's capacitor trip unit is energised via the metering VT. The output from the capacitor trip unit is connected to the trip coil of the metering circuit breaker via an emergency trip button. The emergency trip button shall be positioned within the metering room / enclosure near to the meter panel/s.



**Figure 7      Emergency Tripping**

- 10.4 If the customer requires an additional trip button, or needs to trip NGED's circuit breaker from their protection, they may install a trip receive panel next to the standard intertrip button, as shown in Figure 8. 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 complies with ENA TS 48-4 and includes hand reset contacts and a hand reset mechanical flag / indicator.



**Figure 8 Emergency Tripping – Additional Trip Button**

## 11.0 LV AC AUXILLARY SUPPLIES

- 11.1 Secondary substations often require a 230V LV AC supply for heating, lighting, sockets and, in some cases, for 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 by the responsible customer or IDNO, as applicable, within 12 hours.

### 11.2 Customer Connections

- 11.2.1 Unless otherwise agreed with NGED the HV customer shall provide NGED with a 230V 50Hz LV AC auxiliary rated at 80A derived from their network.
- 11.2.2 Where the HV and LV earthing systems are segregated the LV AC supply shall be connected via a suitable isolation transformer that maintains the required level of isolation between the earthing systems. Further guidance is given in ST: TP21D.
- 11.2.3 At sites with parallel generation, the LV AC supply should remain energised when generator interface protection (e.g. G59 / G99 protection) operates and disconnects the generating units.



### **11.3 IDNO Connections**

- 11.3.1 At IDNO installations the party responsible for providing the LV AC supplies to the substation shall be agreed between NGED 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.
- 11.3.2 Where the HV and LV earthing systems are segregated the LV AC supply shall be connected via a suitable isolation transformer that maintains the required level of isolation between the earthing systems. Further guidance is given in ST: TP21D.
- 11.3.3 At sites with parallel generation, the LV AC supply should remain energised when generator interface protection (e.g. G59 / G99 protection) operates and disconnects the generating units.

### **12.0 BATTERY CHARGER SYSTEMS**

- 12.1 Battery charger systems are required to power the following equipment:
- SCADA / tele-control systems
  - DC powered protection relays
  - Connection Control Panels (CCPs)
- 12.2 In the case of secondary switchgear arrangements the SCADA / tele-control system is normally powered from an integral 12V DC battery charger system supplied as part of the RTU (remote terminal unit) / radio cabinet. The same cabinet includes a 12V DC to 24V DC converter that is used to power the associated 24V DC switchgear actuators and 24V DC powered protection relay, where fitted.
- 12.3 Where a CCP is fitted this includes its own dedicated 48V DC battery charger system.
- 12.4 Each of these battery systems includes self-monitoring systems that raise SCADA alarms if the batter systems are defective.
- 12.5 If a separate battery charger system is required this shall satisfy the requirements of EE SPEC: 104 (24V and 48V Battery Systems) as applicable.

### **13.0 GENERATOR CONNECTIONS**

#### **13.1 Customer Connections**

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

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 NGED to limit or control the power exported by customer generation. Further guidance is given in the TP18 series of documents.
- SCADA control facilities shall be provided for each NGED metering circuit breaker.

- HV Neutral Voltage Displacement shall be provided by NGED 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.

## 13.2 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 of an IDNO HV customer is greater than 500kW:

- NGED recommended that the customer connection is fitted with HV NVD protection.
  - Where the IDNO supplies a single HV customer via a metering unit located at the same site as NGED's switchgear (e.g. using a close coupled arrangement) the NVD requirements specified in clause 13.1 apply. The associated costs are chargeable to the IDNO.
  - In all other cases, the IDNO shall specify the NVD requirements.
- NGED require a NGED owned and controlled Customer Control Panel (CCP) to be fitted at each IDNO HV customer connection. Further guidance is given in the TP18 series of documents.
  - Where the IDNO supplies a single HV customer via metering unit located at the same site as NGEDs switchgear (e.g. using a close coupled arrangement) the CCP is connected to the IDNO's metering unit using Arrangement 2C. In this case the CCP and the associated communication equipment is provided by NGED and the costs are chargeable to the IDNO.
  - 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 NGED free of charge. The installation of this equipment is carried out by the IDNO at their cost (including any additional switchgear and cabling costs etc.).

## 14.0 MULTIPLE CONNECTIONS

### 14.1 Multiple Customer Connections

14.1.1 NGED 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

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

- a risk of paralleling the connections through the customer's network
- complex earthing / bonding issues

- added 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:

It is essential that the multiple connections are not paralleled though the customer's network. If this were to occur this could adversely affect the protection performance or cause high current flow through the customer's network. This flow of current could, in some circumstances, overload cables, switchgear etc. or cause unexpected power flow through the metering (affecting electricity charges or payments).

In order to prevent the customer's network from being paralleled the customer shall either:

- Physically segregate the network supplied by each connection so that interconnection is impossible.
- Fit interlocking to prevent paralleling. This interlocking shall either consist of mechanical interlocking (without over-ride facilities) and/or fail-safe electrical (hard wired) interlocking. Where electrical interlocking is provided any mechanical closing facilities must be disabled to prevent the interlocking from being bypassed.

Software interlocking provided by programmable logic controllers (PLCs), programmable relays or equivalent is not acceptable.

(b) Complex Earthing / Bonding:

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 adequate precautions are not taken. Precautions could include:

- Ensuring metalwork and items of equipment that are connected / bonded to the earth terminal of the separate connections are physically segregated from each other 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, NGED's 11kV and 6.6kV cable screens are bonded to the HV earth electrode at each substation / switch room 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 will be more complex than normal. Appropriate schematic drawings and labels / notices shall be provided at each connection point that clearly state that more than one connection point is provided and describe where the other points of disconnection / isolation are.

14.1.3 It is not acceptable for multiple connections to be provided to a customer site by different DNOs or IDNOs. Where such arrangements are proposed one DNO or IDNO shall adopt the all of the connections to the installation. The only possible exception is where the site is split into distinct geographical areas / buildings that are electrically and physically segregated from each other.

14.1.4 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. The backup connection shall only be capable of being switched on after the normal connection has been disconnected.

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.

14.1.5 If generation is installed that is capable of operating in parallel with NGED'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.

14.1.6 NGED install one emergency trip button per connection point, as standard.

**14.2 Multiple IDNO Connections**

14.2.1 National Grid Electricity Distribution normally provide a single connection to each IDNO Network unless otherwise required for network security reasons, e.g. to ensure the DNO and IDNO networks comply with ENA EREC P2.

14.2.2 Where multiple connections are provided the IDNO may, with NGED's agreement, be able to parallel these connections through their network for short periods of time (e.g. for a few minutes whilst moving open points). Where this is proposed the IDNO may only make the parallel with reference to, and with agreement of, NGED's Control Centre.

14.2.3 IDNOs must ensure that customers connected to the IDNO network cannot parallel between NGED's multiple connections.

## **APPENDIX A            SUPERSEDED DOCUMENTATION**

This document supersedes ST: SD4OA dated April 2019 which has now been withdrawn.

## **APPENDIX B            RECORD OF COMMENT DURING CONSULTATION**

No comments received.

## **APPENDIX C            ANCILLARY DOCUMENTATION**

Electricity Safety, Quality and Continuity Regulations 2002

ENA EREC G83	Recommendations for the connection of type tested small scale embedded generators (up to 16A per phase) in parallel with LV distribution systems
ENA EREC G59	Recommendations for the connection of generating plant to the distribution systems of licensed Distribution Network Operators
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 LV distribution networks on or after 27 April 2019
ENA EREC G99	Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019
ENA TS 48-4	DC Tripping Relays with a Tripping Function in Protection Systems
ST: SDNC1V	Standard Foundation and Enclosure Details and Specifications for 11kV Substation Plant
ST: SD4A	Design of National Grid Electricity Distribution's 11kV and 6.6kV Networks
POL: SP9	Substation Flood Risk Planning and Mitigation
ST: TP14C	Distribution business provided metering facilities
ST: TP21D	11kV, 6.6kV and LV Earthing
ST: TP18A	Application of Generator Constraint Panels
BSCP514	SVA Meter Operations for Metering Systems registered in SMRS

## **APPENDIX D            KEY WORDS**

HV Arrangement, HV Connection, Emergency Tripping, Generation.