

# **Contestable Design**

Neath Resolven Enterprise – 2500kVA  
Contestable Design

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**DOCUMENT DETAILS**

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**REVISIONS**

|       |          |                                                                                                                        |
|-------|----------|------------------------------------------------------------------------------------------------------------------------|
| Rev 0 | 03/02/24 | Original                                                                                                               |
| Rev 1 | 21/03/24 | 1. Amended substation positions.<br>2. Completed bespoke earthing study.<br>3. Removed NGED POC drawing.               |
| Rev 2 | 26/04/24 | 1. Added reference to earthing separation distance drawing and LV supply to NGED substation via isolating transformer. |

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## **1 INTRODUCTION**

IP Electrical Engineers has been appointed as the ICP to carry out the design and equipment installation for Neath Resolven Enterprise.

The details of the connection are as follows:

1 number, three-phase, 11kV, commercial connection with a supply capacity of 2500kVA.

Connection designed to facilitate the installation of 940kW of PV generation. The NGED offer does not give formal approval of any specific PV installation which must be applied for separately.

Connection designed to facilitate the installation of 2000kVA of electric vehicle chargers. The NGED offer does not give formal approval of any specific electric vehicle charger installation which must be applied for separately.

NGED has confirmed the POC will be a break into the existing 11kV 300 CAS cable circuit which is approximately 60m from the proposed location of the NGED substation. The connection will be loop in and loop out using two straight joints onto new 300mm<sup>2</sup>, 11kV, copper, XLPE, 3 x 1 core cable. These two cables will run together and terminate onto the Schneider Electric Ringmain unit at the new NGED substation.

For the location of the POC and the NGED substation and the cable route between the two refer to the following drawing:

Cable Route, Drawing No. EN1337-NRE-CR-001.

The supply to the customer is to be via an IDNO so the metering unit at the NGED substation will be owned by the IDNO and the connection point to the customer will be the outgoing terminals of the IDNO metering unit.

It is the customers responsibility to provide and maintain the customers installation beyond the connection point in conformity with any regulations and orders for the use of electricity on the premises.

## **2 SOURCES OF DATA REFERENCES**

1. NGED connection offer 4496434, dated 28/12/2022
2. NGED proposal plan
3. NGED technical library

## **3 ACCREDITATION**

IP Electrical Engineers are accredited as a utility connections provider on the Lloyds Register, fully accredited for HV design, LV design and

substation installation up to 132kV and cable installation on the NGED network.

#### **4 COMPLIANCE**

The design of the extension to the NGED network will be in full compliance with all relevant NGED standards.

#### **5 SCOPE OF WORKS**

IP Electrical Engineers will be responsible for the design and installation of the contestable equipment.

#### **6 POC**

NGED has confirmed the POC will be a break into the existing 11kV 300 CAS cable circuit which is approximately 60m from the proposed location of the NGED substation. It is proposed to make the break into the existing circuit at the location proposed by NGED.

See the cable route drawing, Drawing No. EN1337-NRE-CR-001.

#### **7 TENURE**

The POC is in the public verge and the cable route to the NGED substation will either be in the public footway or carriageway. The NGED substation is located in private land.

#### **8 NETWORK DESIGN**

##### **8.1 Supply Characteristics**

The supply specification for the POC is:

|                                             |                                                                  |
|---------------------------------------------|------------------------------------------------------------------|
| Nominal Voltage At Connection Point         | 11kV                                                             |
| Number of Phases                            | Three Phase                                                      |
| Nominal Frequency                           | 50Hz                                                             |
| Maximum Export Capacity (MEC)               | 949kVA                                                           |
| Maximum Import Capacity (MIC)               | 2500kVA                                                          |
| Acceptable Power Factor For Export Capacity | 0.95 with a reactive power tolerance of +/- 47kVAr               |
| Acceptable Power Factor For Import Capacity | 0.95 lag to unity with a reactive power tolerance of +/- 125kVAr |

## 8.2 11kV Cable

There is a passing 300 CAS 11kV circuit approximately 60m from the proposed NGED substation location so the POC will break into this cable with a loop in and out to the new substation.

The new cable will be:

300mm<sup>2</sup>, 11kV, XLPE, Single Core Cable, Copper to NG EE SPEC: 82/3 and BS 7870 Part 4.10 specifications.

The existing cable will be cut in the verge opposite the entrance road to Neath Vale Supplier Park. 2.5m x 1m x 750mm joint bays will be excavated to facilitate the installation of 2 x straight joints from the existing cables to the new cables.

The new cable installation consists of the following installation conditions:

|                |                |
|----------------|----------------|
| Section A to B | Road Crossing  |
| Section B to C | Pavement/Verge |
| Section C to D | Road Crossing  |
| Section D to E | Pavement/Verge |

Refer to the cable route drawing, EN1337-NRE-CR-001 for the details of the route.

A bare earth cable will also be run at the bottom of the cable trench and connected to the NGED HV earth bar.

Refer to the trench section drawing, EN1337-NRE-TS-001 for the installation details.

See appendix 3 for the approved plant and equipment list.

## 8.3 Substation Housing

The substation housing is to be a GRP construction with integral meter room.

The connection offer is for a curtailable connection so there is additional equipment to be housed within the substation.

The main items of equipment with the substation are:

1. Ringmain Unit
2. Metering Unit
3. Customer constraint panel (CCP)
4. Easergy T300 RTU

Note that the CCP is mounted to the metering unit and the Easergy T300 RTU is mounted to the Ringmain unit. However their fitment does require additional space in the substation.

The required arrangement is shown in the following NGED drawing:

Standard Technique: NC1V HV Ring Main Unit (RN2D), Metering Room & Generator Constraint Panel Foundation and Layout Details, Drawing No. NC1V-015, Rev No. 1.0

This drawing is shown in appendix 1.

See appendix 3 for the approved plant and equipment list.

## **8.4 11kV Switchgear**

As the connection is curtailable the NGED connection offer specified the following arrangement:

Freestanding 11kV RMU Arrangement 2C (RMU with 400/200/5A MU and Relay and CCP and NVD).

Following correspondence with Schneider Electric and NGED it has been confirmed that the NGED policy has now changed and dual ratio CTs are no longer used. Only single ratio CTs are used so a unit with 400/5A CTs is proposed.

With reference to the NGED standard technique:

Standard Technique SD4OA/1 – 11kV and 6.6kV connections to customers and IDNOs secondary type switchgear arrangements – Type 2C

Arrangement 2 is for single non-extensible Ring Main Unit (RMU).

There are a total of five options as shown in figure 8.1.

So in arrangement 2C a Connection Control Panel (CCP) is required and a DC powered relay with NVD protection.

The close coupled metering unit can be owned by either NGED or an IDNO. In this case the metering unit will be owned by an IDNO.

The section 13 referenced is in relation to generator connections and as the connection is designed to facilitate the installation of 940kW of PV generation this is applicable.

|       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3.2   | <b>Arrangement 2: Single Non-extensible NGED Owned Ring Main Unit (RMU)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 3.2.1 | <p>This arrangement is suitable for loads up to 400A. Five options are described below, and shown in Figure 2 and Figure 3:</p> <ul style="list-style-type: none"><li>• 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.</li><li>• Arrangement 2B is similar to 2A but in this case a CCP is provided as well.</li><li>• 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.</li><li>• 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.</li><li>• 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.</li></ul> |

Figure 8.1 Extract From NGED Standard Technique SD4OA/1

For an agreed export over 500kW a 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.

SCADA control facilities shall be provided for each NGED metering circuit breaker.

From correspondence with NGED it has been confirmed that the CCP is supplied by NGED and that it houses the comms equipment.

Specific details and a schematic diagram for the CCP have not been provided by NGED at this stage.

HV neutral voltage displacement (NVD) shall be provided by NGED or by the customer to disconnect parallel generation. This requirement is mandatory for new connections.

In this case the NVD is to be provided by NGED.

NGED have not confirmed specific details for the protection relay or a switchgear panel type but from correspondence with NGED and Schneider Electric and reference to NGED documentation the following is proposed:

|                                                                                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Schneider Electric Ringmain Unit RN6d                                                                                                                |
| DC Powered Sepam S40 relay with overcurrent, earth fault and NVD protection.                                                                         |
| Motor mechanisms on ring switches 1 and 2 and the tee off metering circuit breaker.                                                                  |
| Easergy T300 remote terminal unit with facility to operate both ring switches and the tee off metering circuit breaker.<br>Mounted to Ringmain Unit. |

|                                                |
|------------------------------------------------|
| Schneider Electric Metering Unit MU6-N46/16    |
| 400/5A, 10VA, Class 0.5s on L1 and L3 Phases   |
| 11000V/ $\sqrt{3}$ , 110V/ $\sqrt{3}$ , 110V/3 |
| Star Winding                                   |
| 50VA, Class 0.5                                |
| Open Delta Winding                             |
| 20VA, Class 3P                                 |
| Facility to mount the CCP                      |

The single line diagram view of this is shown in figure 8.2.

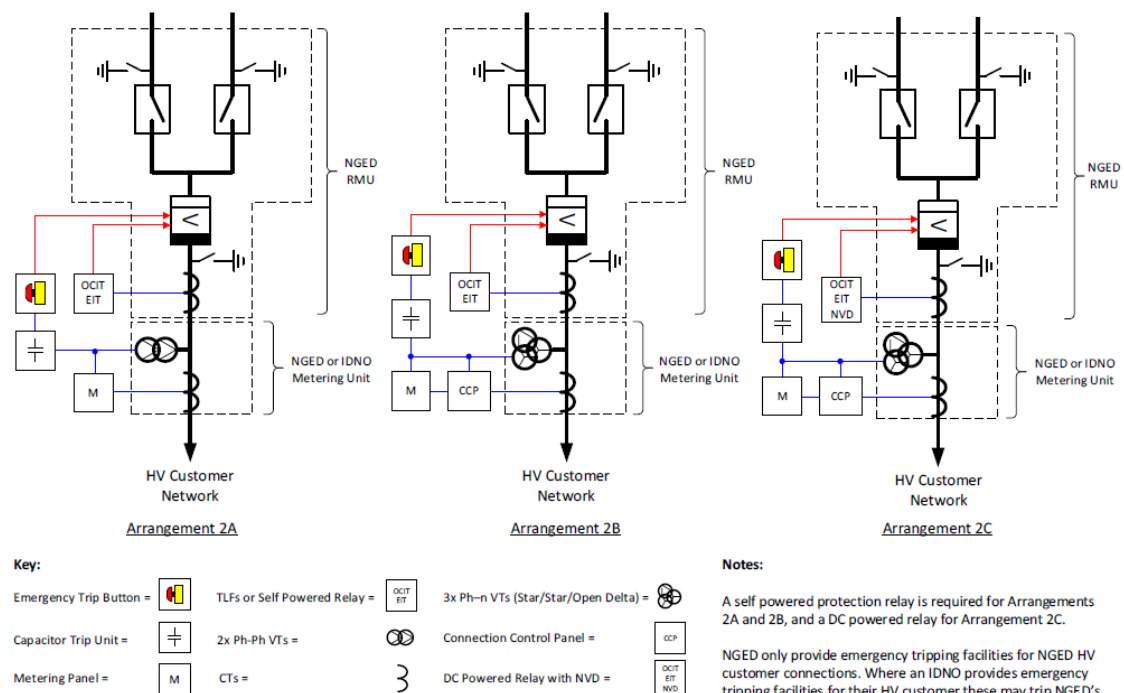


Figure 2 Arrangements 2A, 2B and 2C, Single RMU Connection via a Metering Unit

Figure 8.2 Figure 2 From NGED Standard Technique SD4OA/1

This shows that the star winding voltage reference is connected to the CCP, metering and capacitor trip unit to provide a supply for the emergency tripping circuit.

However the emergency tripping circuit using the capacitor trip unit is only used if NGED are providing the supply to the customer.

Where NGED switchgear is close coupled to an IDNO metering unit, which is the case for this connection. Then the IDNO may offer an emergency tripping facility for their customer. This facility may trip the NGED metering circuit breaker if a shunt trip coil is fitted that is compatible with the IDNOs tripping supply.

It is proposed to supply an emergency tripping facility with a 30V DC switch tripper supply. It has been confirmed with Schneider Electric that the NGED RMU is fitted with a multi voltage shunt trip coil.

Refer to the single line diagram drawing, EN1337-NRE-SLD-001.

## **8.5 Earthing**

To avoid the need to carry out individual earthing designs for every connection, NGED have a range of standard earthing designs. The applicable standard in this case is:

Standard Technique: TP21GG/1 Standard Earthing Designs Part G, HV Connection Substation In a Freestanding GRP or Masonry Housing.

The earthing design is predicated on the exterior walls and doors of the housing being electrically non-conductive and forming a barrier which prevents anyone external to the housing from touching any metalwork which is bonded to the substation HV earth electrode. As the housing is GRP this is the case for this connection.

The standard refers to using the design tool TP21G v2 and following receipt of data from NGED this has been used.

Refer to the Earthing Design Report ER\_NGED\_SWA\_EN1337\_26\_03\_24-11-53-18.

Note that within the report there is a requirement for a minimum HV separation distance of 8m to LV system whose neutral is earthed at a single point. As the transformers and associated LV systems are customer owned the neutral will be earthed at a single point and the 8m separation distance is applicable (as opposed to 3m if the neutral is earthed at multiple points).

This 8m separation distance is shown on the Earth Separation Drawing, Drawing No. EN1337-NRE-ES-001.

The LV supply to the NGED substation should be provided by an isolating transformer mounted in a plastic box to provide double insulation. This will prevent connection of the HV and LV earths via this supply path.

The principle requirements for the electrode are:

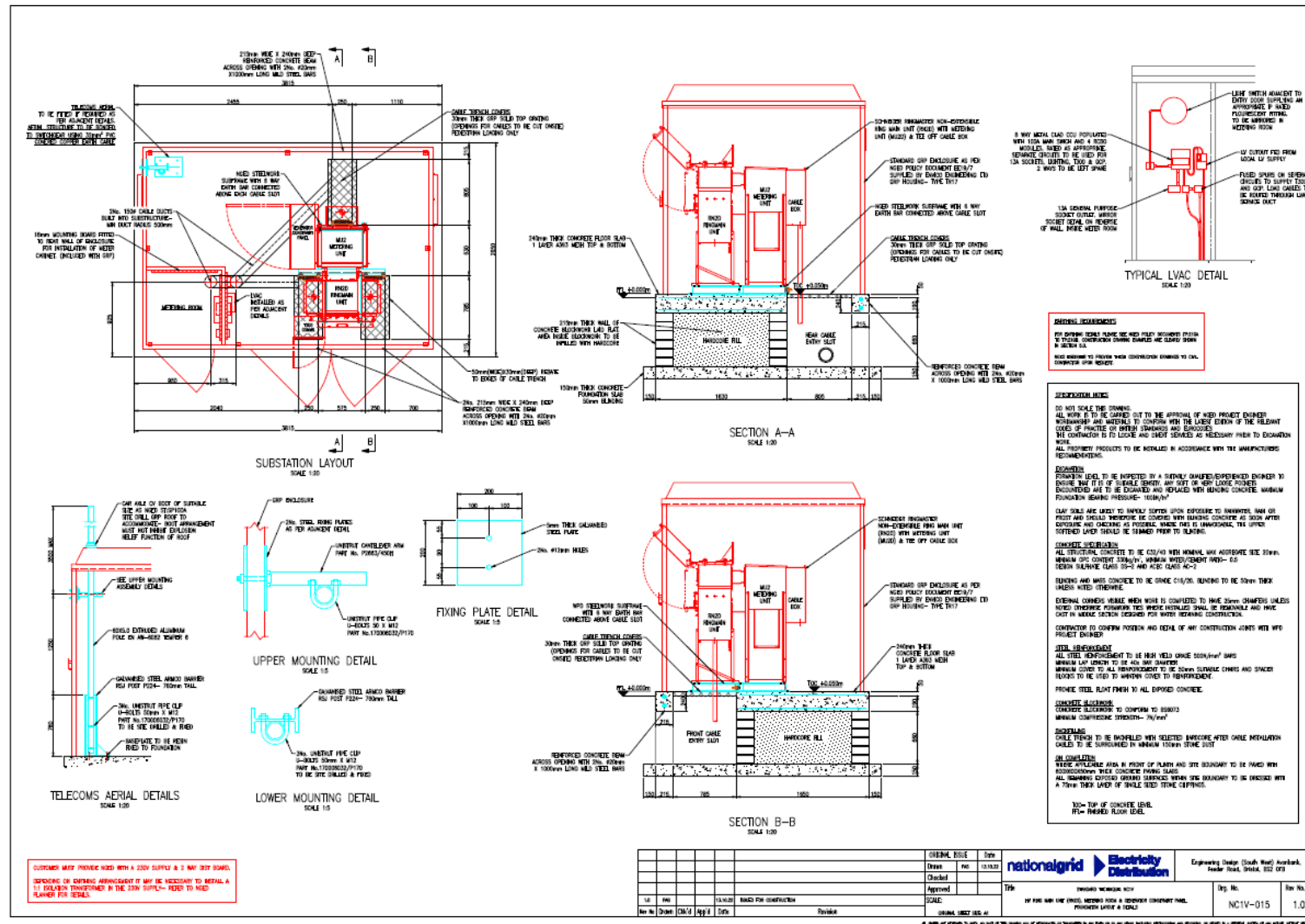
| Item | Description                                                                                                                                       | Details                                                                                                                                                                                                                            |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Continuous ring electrode from the HV earth bar and back to the HV earth bar. 150mm from outer edge of foundations and buried at a depth of 600mm | 70mm <sup>2</sup> bare stranded copper conductor. Copper compression lug on each end.                                                                                                                                              |
| 2    | 4 x earth rods, one at each corner. Connected to the perimeter electrode using a 70mm <sup>2</sup> bare stranded copper conductor tail            | 1.2m, 12.7mm diameter, copper bonded earth rod with exothermically welded tail.                                                                                                                                                    |
| 3    | HV earth bar                                                                                                                                      | At least a 6 way HV earth bar                                                                                                                                                                                                      |
| 4    | HV customer earth bar (located in NGED substation)                                                                                                | At least a 3 way earth bar                                                                                                                                                                                                         |
| 5    | Link from RMU earth bar to HV earth bar                                                                                                           | 70mm <sup>2</sup> bare stranded copper conductor. Copper compression lug on each end.                                                                                                                                              |
| 6    | Link from RMU earth bar to HV customer earth bar                                                                                                  | 70mm <sup>2</sup> bare stranded copper conductor. Copper compression lug on each end.                                                                                                                                              |
| 7    | Connections from RMU earth bar to earth points on all plant items and cable boxes.                                                                | 3 x 25mm <sup>2</sup> copper tape connections                                                                                                                                                                                      |
| 8    | Connection from HV earth bar to two vertical rebar connections brought out from the slab.                                                         | 70mm <sup>2</sup> bare stranded copper conductor. Copper compression lug on each end.                                                                                                                                              |
| 9    | Connections from HV customer earth bar to customer HV electrode                                                                                   | 2 x 70mm <sup>2</sup> insulated stranded copper conductor continuous lengths. Copper compression lug on NGED end. Laid on diverse routes, in 38mm duct for electric cables and bonded to different parts of customer HV electrode. |
| 10   | Additional electrode from HV earth bar to achieve electrode resistance and/or surface area requirement                                            | 70mm <sup>2</sup> bare stranded copper conductor. Copper compression lug on end connected to HV earth bar.                                                                                                                         |
| 11   | If metallic fittings are employed such as ventilation panels, door frames etc connection from RMU earth bar to the metallic fittings              | 16mm <sup>2</sup> green/yellow insulated stranded copper conductor.                                                                                                                                                                |

Also refer to the drawing in appendix 2.

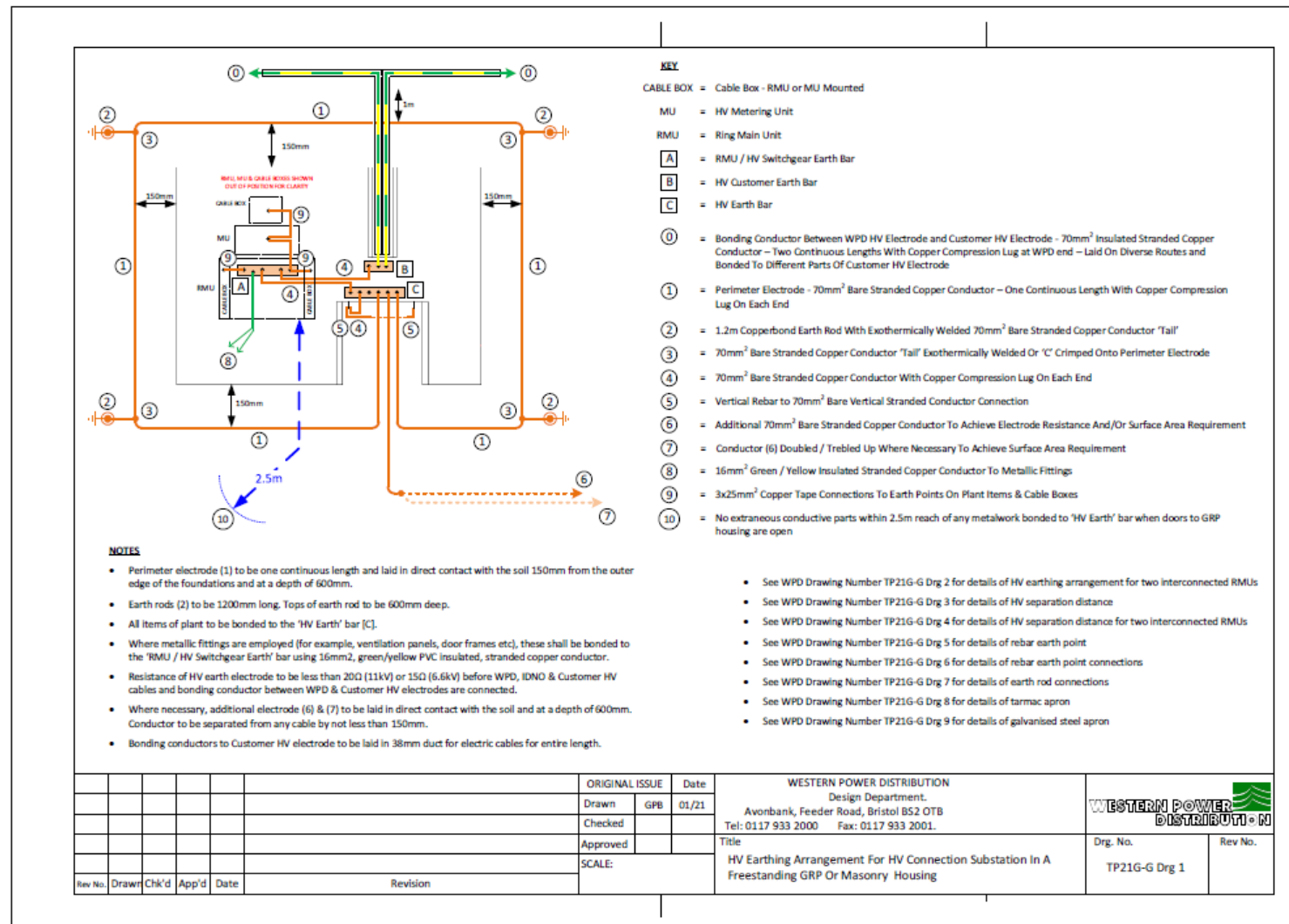
It is proposed that item 10, the additional electrode to achieve electrode resistance and/or surface area requirement, is installed at the bottom of the HV cable trench for the full 75m length.

Refer to the trench section drawing, EN1337-NRE-TS-001 for the installation details.

## APPENDIX 1      NGED Substation Layout



## APPENDIX 2      NGED HV Earthing Arrangement



**APPENDIX 3      Approved Plant and Equipment List**

| Component                             | NGED Specification | National Specification | Manufacturer                     | Size/Type                                                                                                                                                       |
|---------------------------------------|--------------------|------------------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11kV, XLPE, Single Core Cable, Copper | NG EE SPEC:82/3    | BS 7870 Part 4.10      | Prysmian Cables<br>Nexans Cables | 300mm <sup>2</sup><br>400mm <sup>2</sup><br>630mm <sup>2</sup>                                                                                                  |
| 11kV Straight Joints                  | NG EE SPEC:112     | HD 628 & 629           | Lovink                           | K85 – 95 to 185mm <sup>2</sup><br>K95 – 185 to 400mm <sup>2</sup>                                                                                               |
| 11kV Compound – Jointing Compound     | NG EE SPEC:112     | HD 628 & 629           | Lovink                           | Lovisil                                                                                                                                                         |
| 11kV Ducts                            |                    | ENATS 12-24 Class 1    | Rigiduct                         | 178mm O/D, 150mm I/D, Coloured Black, Bends should be a minimum of 1200mm radius                                                                                |
| Connectors 11kV Terminations          | NG EE SPEC:111     | IEC 61238-1            | TE Connectivity (B&H)            | BAH-02-403-0127<br>BAH-02-403-0100<br>BAH-02-403-0128<br>BAH-02-403-0129<br>VETB33-12UTB<br>VETC330HUTB<br>VET28-12/16 UTB<br>VET28-OHUTB<br>BET Lugs<br>LBE 95 |

| Component                                             | NGED Specification | National Specification | Manufacturer                                | Size/Type                                                                                                                                  |
|-------------------------------------------------------|--------------------|------------------------|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Connectors 11kV                                       | NG EE SPEC:111     | IEC 61238-1            | TE Connectivity<br>(B&H)                    | MSFE-0009-0035/0185<br>MSFE-0010-0035/0300<br>BAH-02-211-0098<br>VTPC36UTB<br>HVBRM18SPUTC<br>HVBRM22SPUTC<br>HVBRM18SOUTC<br>HVBRM22SOUTC |
| 12kV Circuit Breaker<br>Ring Main Unit SF6            | NG EE SPEC 2/5     | ENATS 41-36            | Schneider – Leeds<br>W Lucy & Co -<br>Thane | Txf Mounted RMU<br>Free St RMU                                                                                                             |
| GRP Enclosure With<br>Internal Arc Pressure<br>Relief | NG EE SPEC 19/6    |                        | Morgan Marine -<br>Swamsea                  | V Resistant<br>3050x2225x2300mm<br>3050x1830x2300mm<br>Unit S/S Enc<br>3050x1830x2300mm<br>3050x2225x2300mm                                |
| Earth Rods                                            |                    | ENATS 43-94            | W Furse -<br>Nottingham                     | 1.2m, 12.7mm<br>diameter, copper<br>bonded earth rod                                                                                       |