

NETWORK ASSETS

LV NETWORK DESIGN

Policy 09/020 v3

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This policy will come into effect ten working days from the issue date stated above.

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FOREWORD

This policy is issued under the direction and with the approval of the Network Development Manager.

This is the second version of the document to be issued.

Access to policy and procedure documents is now provided via the NIE Networks' Intranet, The Wire. This revision has been prepared to take account of the revised process for the management of documents in the intranet environment.

INTRODUCTION

This Policy sets out the principles and practices that shall be adopted for the design of LV networks owned and operated by NIE Networks.

This document shall be used in conjunction with the following NIE Networks Policy and Procedure Documents:

09/021 Design of Low Voltage Connections to Commercial and Industrial Premises

09/022 Design of Low Voltage Connections to Domestic Premises

9/026 Policy for the Connection of Low Carbon Technologies with a Capacity ≤ 32 A per phase

9/027 Policy for the Connection of Low Carbon Technologies with a Capacity > 32 A per phase

1. TERMS AND DEFINITIONS

For the purposes of this document the following terms and definitions apply:

Customer - A person (or persons) supplied with electricity at any premises. This includes domestic and commercial/industrial supplies.

Point of Supply (PoS) - The ends of the electric lines situated upon any customer's premises at which a supply is delivered and, unless otherwise agreed in writing, where a meter is employed to register the quantity of the supply and is directly connected to those lines.

High Voltage (HV) - Voltage above 1000 V but less than or equal to 20,000 V r.m.s.

Low Voltage (LV) - Voltage above 50 V RMS but less than 1000 V r.m.s.

Prospective Short-Circuit Current (PSCC) - The maximum current that would flow in a circuit in the event of a short circuit of zero impedance at the point of fault.

Earth Fault Loop Impedance (EFLI) - The impedance of the earth fault current loop external to the customer's installation starting and ending at the point of earth fault. BS 7671 denotes this impedance by the symbol Z_e .

Loop Impedance - Phase to neutral loop resistance including the transformer, distributor and service

SNE - Separate Neutral and Earth (cable)

CNE – Combined Neutral and Earth (cable)

CT – Current Transformer

PME – Protective Multiple Earthing

MIC – Maximum Import Capacity

2. NETWORK DESIGN PRINCIPLES

The design shall ensure that the electrical system can be constructed, operated and maintained safely and effectively. Reference should be made to relevant Regulations, including the Construction Design and Management Regulations (NI) 2016 and the Electricity Safety, Quality and Continuity Regulations (NI) 2012.

2.1 CDM

Construction Design and Management (CDM) Regulations remain paramount at all stages of the design process, including requirements to identify, reduce or remove risk at the design stage and if necessary liaise with other designers to develop safe designs.

Designers shall ensure each design complies with the requirements of CDM and in accordance with HSG - 028 CDM 2016 Guidance.

2.2 ESQCR

Designers shall ensure compliance with the requirements of ESQCR (NI) 2012 and NIE Networks distribution networks shall be designed to comply with these regulations.

2.3 Design

All new connections to the NIE Networks LV Distribution Network shall comply with design standards ensuring supply characteristics are within limits.

In addition to designing a new network, an assessment of the existing network shall be required to ensure that new loads can be accommodated and that volt drop is not compromised on the existing network.

2.4 System Development

The general objective is to obtain a simple, robust, economical and efficient network, considering the initial capital investment, system losses, maintenance costs and operation costs over the life of the asset.

In general, development of the LV and HV systems shall seek to improve the quality and reliability of supply provided to Customers and to reduce potential Customer Minutes Lost (CML) and Customer Interruptions.

The connection arrangement and nature of a Customer's new or additional load shall not disadvantage, or put at material greater risk, supplies to other Customers connected to that part of the distribution system.

2.5 Maximum LV Serviced Load

Loads up to a maximum of 1000 kVA can be connected at LV, supplies above 1000 kVA shall only be offered at 6,600 volts or above.

Requirements for connections at 6,600 volts and above are detailed in NIE Networks Policy and Procedures Document 10/017 'Customer Supplies metered at 6.6 kV or 11 kV'.

2.6 LCTs

Low carbon technologies to be connected to the LV distribution network, e.g. electric vehicle charging points (EV) and domestic heat pumps (HP). The addition of low carbon loads is notifiable to NIE Networks (for example heat pumps and EV chargers). This data shall be collected for network planning and design use.

2.7 Legalities

Legal rights to the placing of equipment shall be secured before any asset is installed or erected on site.

It is a requirement to obtain the necessary lease agreements, vehicular rights of way, cable easements or wayleaves appropriate for the type of equipment being installed.

3. SUPPLY CHARACTERISTICS

3.1 Voltage

The declared voltage in respect of low voltage will be the supply voltage at the PoS (+10/-6%) and represents ESQCR requirements.

3.1.1 Single Phase

The declared voltage in respect of low voltage single phase shall be 230 volts (+10/-6%) between the phase and neutral conductors at the supply terminals.

3.1.2 Three Phase

The declared voltage in respect of low voltage three phase shall be 400 volts (+10/-6%) between the phase conductors at the supply terminals.

3.2 Frequency

The Frequency shall be 50 hertz with a variation not exceeding 1% above or below (+1%/-1%) the declared frequency, 49.5 Hz to 50.5 Hz.

3.3 Phasing

Low voltage mains and services will be three phase and single phase as required.

3.3.1 Phase Rotation

Phase rotation will normally be L1-Brown, L2-Black, L3-Grey (L1-Red, L2-Yellow, L3-Blue) in time sequence.

Within Belfast district phase rotation will normally be L3-Grey, L2-Black, L1-Brown (L3-Blue, L2-Yellow, L1-Red) in time sequence.

It is the responsibility of the customer to confirm phase rotation prior to connecting equipment.

3.3.2 Phase Balance

In respect of three-phase connections, the customer shall ensure the total load is balanced as accurately as possible over the three phases

3.4 Fault Current

Requirements for fault current or prospective short circuit current (PSSC) shall be in accordance with NIE Networks policy and procedures document 09/013, Prospective Fault Current and External Earth Loop Impedance. Maximum PSSC values at the PoS are detailed in Table 1.

	PSSC at PoS
From Pole Mounted Transformer/Low Voltage Network System	10,000 A
From Ground Mounted Transformer (up to 800kVA)	16,000 A
From Ground Mounted Transformer (up to 1000kVA)	27,000 A

Table 1: PSSC values at PoS.

3.5 Earth Fault Loop Impedance

Earth fault loop impedance shall be in accordance with NIE Networks policy and procedures document 09/013, Prospective Fault Current and External Earth Loop Impedance. Typical earth fault loop impedance values at the PoS, are detailed in Table 2.

Service	Earthing	EFLI
Up to 100amp single-phase	PME terminal	0.35 Ω
	TNS, cable sheath or continuous earth wire terminal	0.8 Ω
Three Phase (<200amps)	PME terminal	0.35 Ω
	TNS, cable sheath or continuous earth wire terminal	0.8 Ω
Three Phase (200 to 300amps)	PME terminal	0.2 Ω
	TNS, cable sheath or continuous earth wire terminal	
Three Phase (>300amps)	PME terminal	0.15 Ω
	TNS, cable sheath or continuous earth wire terminal	

Table 2: Typical Earth Fault Loop Impedances at PoS.

3.6 Loop Impedance

Loop impedance at the PoS shall not exceed 0.25 Ω

Low voltage system loop impedance should be calculated as part of the design procedure. To limit voltage fluctuation, phase to neutral loop resistance should not exceed 0.25 ohms including the transformer, distributor and service. The loop resistance of the services at the extremities of the network should not normally exceed 0.05 ohms.

3.7 Power Quality

The connection of all equipment likely to cause voltage fluctuations, voltage unbalance or generate harmonics, such as motors and welding equipment need to be assessed on an individual basis and the design for the connection of such equipment should be carried out using the appropriate network design tool or method to ensure compliance with the following engineering recommendations and NIE Networks policies and procedures.

- Voltage Fluctuations (ENA ER P28) and Network Policy and Procedures Document 11/005 'Planning Limits for Voltage fluctuations caused by industrial, commercial and domestic equipment – ER P28'.
- Voltage Unbalance (ENA ER P29)
- Limits for Harmonics (ENA ER G5)

3.8 Power Factor

Customers should be encouraged to aim for a power factor of between 0.95 lagging and unity at the Point of Supply in order to contribute to maintaining an efficient electrical distribution network.

4. DESIGN REQUIREMENTS

LV distributors shall be designed on the principle of underground radial mains, considering:

- Potential Interconnection to adjacent networks
- Potential future load growth
- Customer numbers and load requirements

Ensuring that each connection meets the technical requirements for voltage, frequency, loop impedance, power quality and protection.

Exceptionally in rural areas overhead lines may be used where the use of underground cable is not reasonably practicable.

4.1 Network Design Tool

A suitable modelling tool (e.g. Win-Debut) shall be used in the design of all: new LV networks, extensions to existing networks and service connections to existing LV networks.

Data provided by the model shall include:

- Cable sizes.
- Loop impedance
- Earth Fault loop impedance.
- Voltage drop.
- P28 Voltage dip associated with motor starting, welding equipment and electric loads.
- Fusing and fuse size.
- Fault current

NIE Networks preferred method for design is using 'WinDEBUT' design package. This package will calculate volt drop, EFLI, Voltage Quality and cable capacity at each node on the network and highlight any issues.

Calculations can be made using other calculation methods or design tools, although design verification by NIE Networks shall be carried out using WinDEBUT.

4.2 Distributor and Service Volt Drop Design

Total volt drop at the PoS shall not exceed 6%, of which:

- volt drop on a distributor shall not exceed 5%.
- volt drop on a service, connected to a distributor, shall not exceed 2%.

Volt drop on services directly connected to secondary substations shall not exceed 6%.

4.3 Fusing

Fusing requirements for LV networks shall be in accordance with NIE Networks policy and procedures document 3/006 'Fusing in Distribution Networks'.

4.4 Earthing

Earthing requirements for LV networks shall be in accordance with NIE Networks Policy and Procedures Documents:

2/002, 'LV Network Earthing'.

4.5 LV Network Interconnection

To meet current required levels of continuity of supply, distribution substations should be interconnected on the low voltage network to facilitate maintenance of substation plant and to speed post fault restoration.

The provision of LV back-feeds and/or facilities for the connection of mobile generators is an integral part of network design.

Where practicable new networks shall be designed to achieve network support by interconnecting two or more LV feeds from adjacent substations.

Interconnection by LV cables should normally be provided to the extent of one third of the substation's ultimate load providing an accessible LV source is available.

The normal load on interconnecting LV cables is reduced to one third of their maximum connected load when assessing the available Interconnection capacity.

In addition, when a new substation is installed, the opportunity should also be taken to ensure this requirement is available to adjacent existing LV network substations.

The possibility of future adjacent developments shall also be considered.

4.6 Phased Developments

The designer shall consider the future development of the HV and LV system.

Where further phases of the housing development are planned this should be considered when determining the rating and location of apparatus.

This approach avoids excavation and reinstatement of recently constructed road and pavements.

The designer shall discuss with the housing developer the costs and benefits of additional features to reduce the need to re-excavate new reinstatement and features to improve customer's security of supply.

Where the same developer is involved in successive phases of a development, they can minimise their overall costs by making early provision for future phases. For example, locating a substation in the centre of the overall development rather than in the centre of the first phase.

At all times NIE Networks shall:

Take steps to minimise overall expenditure (although it is for customers / developers to consider (and make) investments in infrastructure which minimise their overall costs).

Take all reasonable steps to make such opportunities visible to developers.

Consider the implications of operational / performance constraints that will apply to the final overall development and take steps to minimise the total cost of complying with these constraints.

4.7 Clearances to Gas Installations

Clearance requirements for of indoor and outdoor meter positions from low and medium pressure gas installations are outlined in Table 3 below.

Table 3 Clearances for meter positions from gas installations

	Low Pressure Gas Installation	Medium Pressure Gas Installation
Indoor (mm)	150	N/A
Outdoor (mm)	300	1550

5. LV CABLES

5.1 LV Distributor Cables

Cables in use on the NIE Networks distribution network are detailed in NIE Networks Policy and Procedures Document 5/014, 'Electrical Characteristics and Ratings of Buried Cables up to 11 kV'.

The use of 4-core cables shall be in accordance with Network Policy and Procedures Document 5/011, 'Use of PILC and Split Concentric Cables on LV Systems'.

Where new LV circuits or extensions are proposed within new developments the new assets shall be adequate for future LCT demand connecting. This can be achieved by designing the new assets for the LCT ready maximum demand. The LCT-ready maximum demand on an asset can be determined using the LCT-ready ADMD table in Appendix A.

5.1.1 Standard LV Cables

LV Cables approved for use on the NIE Networks distribution system are:

- 300 mm² Aluminium Waveform underground cable.
- 240 mm² Aluminium Waveform underground cable.
- 185 mm² Aluminium Waveform underground cable.
- 95 mm² Aluminium Waveform underground cable.

5.1.2 Minimum Distributor Cables Size

New underground mains cables to be used in mains distributors providing interconnection and distributors capable of being extended to make interconnection shall be a minimum of 185 mm² Al waveform.

5.1.3 Spurs

95 mm² AL waveform can be used on branches/spurs, jointed to distributors with no future potential for interconnection, e.g. cul-de-sacs.

5.1.4 Tapering

A tapered distributor shall utilise a minimum cable size of 185 mm² Aluminium.

5.1.5 Cable Derating Factors

Ducted & Grouped

Rating for ducted and grouped Low Voltage cables are detailed in NIE Networks Policy and Procedures Document 5/014.

5.1.6 Phase Balance

In order to minimise voltage drops on distributors, successive service connections shall be made to the distributor's phases in the sequence L1, L2, L3, L1, L2, L3, etc. The whole treatment of voltage drop calculation is based on this sequence of service connections being followed and it shall, therefore, be strictly adhered to.

5.1.7 Three phase cables on single phase networks

The connection of a 3 phase cable to a single phase network shall have all three phase conductors connected at the supply point thereby energising all conductors. Any subsequent dwellings connected to the cable should then have their service cable phase conductor connected in turn to each of the mains cable phase conductors.

With such an arrangement, the maximum load that can be connected must not exceed that which could be connected to a single phase network as the neutral conductor will limit the maximum allowable current.

5.2 Services

5.2.1 Single Phase Services

The design of each normal domestic service shall be based on a prospective load of 18 kW (80amps) with no allowance made for diversity.

Services up to 18 kW shall be made using a 35 mm² AL service cable installed up to a maximum length of 33 metres.

5.2.2 Service Cable Routes

The following considerations apply when designing the service cable route:

- The service cable shall be as short as practicable subject to the maximum length.
- Individual service cables shall be installed from the distributor to each property.
- Each service cable shall be run in a NIE Networks approved 38 mm diameter duct.
- Each service shall follow a direct route with a continuous run length not exceeding 33 metres from the service termination position to the service joint position.
- For housing developments service cables shall not pass through adjacent plots of land or plots of land owned by third parties.

5.2.3 Looped Services

Looped services are not permitted as an acceptable service arrangement.

5.2.4 Distribution of Services

Services to be supplied from a new LV network shall be evenly distributed across the three phases to avoid overload of a single phase.

In order to minimise voltage drops on distributors, successive service connections shall be made to the distributor's phases in the sequence L1, L2, L3, L1, L2, L3, etc. The whole treatment of voltage drop calculation is based on this sequence of service connections being followed and it shall, therefore, be strictly adhered to.

5.3 Cable Installation

The cable installation requirements for LV networks are detailed in NIE Networks policy and procedures document 05/009 'LV to 33 kV Underground Cable Installation'.

5.3.1 Duct Sealing

The method for sealing ducts is detailed in NIE Networks policy and procedures document 5/022 'Method for Sealing Ducts'.

5.4 Recording of Assets

Recording of assets shall be in accordance with Network Policy and Procedures Doc. 1/010, 'Asset Records'.

6. DISTRIBUTION SUBSTATIONS

6.1 Design Guidance

The following documents provide guidance to designers of LV networks when choosing the type, size and location of distribution sub-stations:

- Series 07 NIE Networks Policy and Procedures documentation.
- 03/006 'Fusing in Distribution Networks'.
- 20/001 'Provision of Substations by NIE Networks in New Developments'.
- 20/002 'Guidelines on Improving the Environmental Impact of Existing Secondary Substations'.

6.2 Transformer Sizing

For design purposes the total load on the transformer shall not exceed its nameplate rating

The minimum size of distribution transformer proposed for town centre networks shall be 500 kVA complete with a minimum 6 way LV cabinet.

Sub-stations established purely for a single customer should be sized according to the agreed customer's MIC and in accordance with NIE Networks Policy 03/006 'Fusing in Distribution Networks'.

25 kVA single phase transformers shall be the minimum size of distribution transformer to be used for new and increased supplies.

16 kVA single phase transformers will no longer be available as a new stock item.

Existing 16 kVA single phase transformers in good condition, retained in stock as spares may be used for the replacement of existing single phase transformers of similar rating, or for paralleling to provide increased single phase capacity, subject to the criteria set down in section 6.5, Paralleling of Transformers.

Where new sub-stations or transformers are proposed within new developments the new assets shall be adequate for future LCT demand connecting. This can be achieved by designing the new assets for the LCT ready maximum demand. The LCT-ready maximum demand on an asset can be determined using the LCT-ready ADMD table in Appendix A.

6.2.1 Transformer Sizing and Maximum Fuse Size

Distribution transformers shall be sized in accordance with NIE Networks policy 03/006 'Fusing in Distribution Networks' and ENA TS 12-8.

Transformer sizing shall be based not only on the prospective load but also on the protection fuse size.

To comply with ENA TS 12-8, LV protection arrangements >630 amps, require a LV circuit breaker or shall be referred to a Protection Engineer for approval of the proposed protection arrangement.

Distribution Sub-station LV cabinet fuse contacts are rated at 500 amps, for 630 amps fusing, fit 2 x 315 amp fuses and parallel kit.

6.3 Distribution Substation Types

Distribution transformers having a capacity greater than 200 kVA shall be cable-fed ground-mounted transformers, complete with an appropriately rated LV cabinet (4, 6 or 8 way) with facilities for connecting a ring main unit, transformer fuse switch or cable termination chamber.

Transformers In rural areas to be supplied from an overhead network having a capacity 200 kVA or less will generally be a pole mounted transformer in line with ESQCR requirements or

alternatively pad mounted transformers are available to facilitate the connection of individual commercial customers or LV cable networks supplied from 11kV rural overhead lines.

315kVA pole mounted transformers are available to replace existing assets within Secondary Asset Replacement (SAR) only. All proposals must be submitted to Network Assets for approval before construction. This takes into consideration the complex location of existing assets, along with suitable location and weight of new 315kVA pole mounted transformer.

6.3.1 Ground Mounted Transformers

Ground mounted standard transformer ratings approved for use on the NIE Networks distribution network for new or increased supplies are detailed in NIE Networks equipment specification 200/03A and in table 3.

TYPE	CONFIGURATION	VOLTAGE RATIO (No Load)	kVA RATING
1	In – line Trunking	11000/416 - 240	500 800
4	Unit substation Tx	11000/416 - 240	500 800 1000
4	Unit substation Tx	HV 11000/6600 -LV 416 - 240	500 800 1000
4a	Unit substation style	33000/416 - 240	500 800

Table 3 – Ground Mounted Transformer Ratings

6.3.2 Pole Mounted Transformers

Pole mounted standard transformer ratings approved for use on the NIE Networks distribution network for new or increased supplies are detailed in NIE Networks equipment specification 200/03B and in table 4. With the exception 315kVA pole mounted transformers, which are only for use by Secondary Asset replacement (SAR).

Voltage Ratio (no-load)	kVA ratings	kVA ratings
	Single Phase (Type 3)	Three Phase (Type 2)
6600/240	25 50	
6600/416 - 240		50 100 200
11000/240	25 50	
11000/416 - 240		50 100 200 315

33000/240	25 50	
33000/416 - 240		50 100 200

Table 4 - Pole Mounted Transformer Ratings

6.3.3 Pad Mounted

Pad mounted standard transformer ratings approved for use on the NIE Networks distribution network for new or increased supplies are detailed in NIE Networks equipment specification 200/05 and in table 5.

Voltage Ratio (no-load)	kVA ratings	Type
11000/240	50	P1
6600/240	50	P1A
11000/416-240	100	P2
6600/416-240	100	P2A
11000/416-240	200	P3
66000/416-240	200	P3A

Table 5 – Pad Mounted Transformer Ratings

6.4 Distribution Transformer LV Arrangements

Only one fusing arrangement shall be provided at a transformer, which shall be either 1 set of LV pole-mounted cut-outs or an LV cabinet for multiple fused circuits. 2 or more sets of LV pole mounted cut-outs is not a recommended arrangement.

e.g. if an existing 200 kVA pole mounted transformer has a single cable connected via a set of pole mounted cut-outs and a second cable is to be connected to this transformer and is to be separately fused, the set of pole mounted cut outs shall be removed and an LV cabinet shall be installed with cables connected to separate fuse units.

6.4.1 Single Phase Pole mounted

Phases	kVA	Max. No of LV ccts	Standard LV Fusing Arrangement	NIEN Spec 205-03 Drawing No.
Single phase	5, 16, 25 or 50	1	1 x Pole mounted single phase cut-out	81-2017-0232
Single phase	2x 5, 2x 16 or 2x 25	1	2 x Pole mounted single phase cut-outs (1 per TX)	81-2017-0233

6.4.2 Three Phase Pole Mounted

Phases	KVA	Max No. of LV ccts	LV Fusing Arrangement	Mounting	NIEN Spec 205-03 Drawing No.
Three	25 or 50	1 cct	1 x 3 Phase Pole Mounted cut-outs	Single pole	81-2017-0234

Three	100	1 cct	1 x 3 Phase Pole Mounted cut-outs	Single pole	81-2017-0235
Three	100	>1 cct	LV Cabinet (To NIEN Spec 201-07)	H-pole	81-2017-0237 or 81-2017-0270
Three	200	1 cct	1 x 3 Phase Pole Mounted cut-outs (up to 138 kVA)	H-pole	81-2017-0236
Three	200	>1 cct	LV Cabinet (To NIEN Spec 201-07)	H-pole	81-2017-0237 or 81-2017-0270
Three	315	>1 cct	LV Cabinet (To NIEN Spec 201-07)	H-pole	81-2017-0270

When constructing a H-pole to 81-2017-0270 complete with 315kVA transformer, additional stock items are required and are listed in the table below.

ITEM	STOCK NUMBER
Space bar for 315kVA Transformer	325/1618
300sqmm Brass shear off lug	355/4151
300sqmm Transformer tails black PVC/ PVC	350/1345

6.4.3 Ground Mounted

Low voltage distribution cabinets to NIE Networks specification 201-07 are available with the following number of outgoing ways and associated ratings:

- LV Cabinet 4 outgoing fused units rated at 800 amps
- LV Cabinet 6 outgoing fused units rated at 1600 amps
- LV Cabinet 8 outgoing fused units rated at 1600 amps.

6.4.4 Temporary Generation Connections

All new LV fuse cabinets associated with HV/LV transformers shall include a means of connecting temporary LV generation.

6.5 Paralleling of Transformers

6.5.1 Single Phase Transformers

The paralleling of two single phase transformers up to 25 kVA, of identical rating (a matching pair), to provide increased single phase capacity is permitted.

Where parallel single phase transformers are being erected or altered, it is good engineering practice to erect or replace the existing arrangement with two matching transformers:

- from the same manufacturer and production batch, preferably having sequential serial numbers.
- having identical rating, ensuring impedance, capacity and voltage matching

Figure 1- Example of parallel single phase transformers recorded in Maximo Plant

Serial Number	Asset	Asset Description	Location	Location Description
		»		» Ballycullen A
C33 4540	50052340	25KVA 11/24KV UNIDARE TRANSFORMER	10053621	BALLYCULLEN A SEC TX 1
C33 4541	50052341	25KVA 11/24KV UNIDARE TRANSFORMER	10053622	BALLYCULLEN A SEC TX 2

Fusing arrangements shall be in accordance with NIE Networks policy and procedures Document 3/006, 'Fusing in Distribution Networks'.

6.5.2 Three Phase Transformers

The paralleling of 3 phase distribution transformers is NOT permitted.

The paralleling of 3 phase distribution transformers connected directly together via a common LV busbar can lead to excessive fault current, inadequate protection and additionally if at a customers switch panel, load cyclic and consumption measurement accuracy issues.

At existing arrangements where the paralleling of 3 phase distribution transformers was designed to create LV capacity up to 1600 kVA and the customer retains this arrangement, the customer's switch panel must have an open LV section switch, with castell interlocking, separating each incoming supply feeder cables.

6.6 Location of Substations

The substation position should be as near as possible to the centre of the load it is intended to supply or directly adjacent to the customers supply intake position and in such a manner that proposed LV distributors can radiate easily in all directions.

The following factors should be considered when selecting substation positions:

- large loads may develop at schools, shopping precincts, etc;
- future development of adjacent land;
- source and method of providing HV supply;
- reinforcement of existing LV systems;
- the existing building line (substations should normally be on or behind the imposed building line).

6.7 Substation Access

The proposed site should be selected to ensure sufficient access available at all times from the public highway for the operation, maintenance and replacement of plant.

6.8 ESQCR Risk Assessment

Designs shall be in accordance with Network Policy and Procedures Document 20/005 'ESQCR Policy, Assessing the Risk to the public from NIE Networks Assets'.

6.9 Substation Earthing

Designs shall be in accordance with Network Policy and Procedures Document 2/011B 'Earthing of 11 kV and 6.6 kV Ground Mounted Substations'.

7. SECTIONALISERS

Section pillars and Underground Distribution Boxes (UDBs) are primarily intended for splitting interconnecting networks.

Low voltage sectionalizing pillars and UDBs should be situated in accordance with the optimum network configuration subject to statutory consents.

7.1 Section Pillars

Two and four-way section pillars are available for use on new LV networks. These section pillars are designed to accept links but will not accommodate the connection of domestic service cables.

7.2 Underground Distribution Boxes

The use of UDBs is recommended where sectionalizing of LV circuits is required and the installation of a section pillar would create an obstruction to pedestrians or result in a reasonable objection from adjacent property owners. This means that UDBs tend to be more appropriate in high density built up areas and, consequently, are mainly utilized in the Belfast.

The installation/construction process requires careful consideration of the benefits gained before a UDB can be justified.

8. EXISTING NETWORKS

Various items of equipment on existing underground and overhead LV networks require replacement for various reasons including overloading, voltage issues, condition based, end of life or change in practice. Diversions will also require the replacement of existing LV networks.

In all cases, consideration shall be given to network rationalisation and potential redesign should an opportunity be presented.

Network connectivity, the ability to transfer and support customers under outage, the introduction of more effective equipment and increased network efficiency should all be considered whenever possible. This may require increasing the capacity of the LV network rather than a like for like replacement

The capacity of the LV network shall not be de-rated by any replacement work and tapered LV mains shall be avoided.

When replacement is required:

- Underground cables shall be replaced with a minimum 185 mm² AL cable.
- Overhead lines shall be considered for replacement with underground networks at every opportunity.
- Where the retention of overhead lines is unavoidable, conductors shall be replaced with ABC of an equivalent rating.
- LV Pillars shall be replaced with section pillars ensuring that, as a minimum requirement, the LV network connectivity is maintained on a like for like basis.

Appendix A LCT-ready ADMD Table

No. of Dwellings	LCT Ready ADMD (kVA)	No. of Dwellings	LCT Ready ADMD (kVA)	No. of Dwellings	LCT Ready ADMD (kVA)	No. of Dwellings	LCT Ready ADMD (kVA)	No. of Dwellings	LCT Ready ADMD (kVA)	No. of Dwellings	LCT Ready ADMD (kVA)
1	18.0	51	5.3	101	4.5	151	4.0	201	3.7	251	3.5
2	12.5	52	5.3	102	4.5	152	4.0	202	3.7	252	3.5
3	11.2	53	5.3	103	4.4	153	4.0	203	3.7	253	3.5
4	10.4	54	5.3	104	4.4	154	4.0	204	3.7	254	3.5
5	9.8	55	5.2	105	4.4	155	4.0	205	3.7	255	3.5
6	9.4	56	5.2	106	4.4	156	4.0	206	3.7	256	3.5
7	9.0	57	5.2	107	4.4	157	4.0	207	3.7	257	3.5
8	8.7	58	5.2	108	4.4	158	4.0	208	3.7	258	3.5
9	8.4	59	5.1	109	4.4	159	4.0	209	3.7	259	3.5
10	8.2	60	5.1	110	4.4	160	4.0	210	3.7	260	3.5
11	8.0	61	5.1	111	4.4	161	4.0	211	3.7	261	3.5
12	7.8	62	5.1	112	4.4	162	4.0	212	3.7	262	3.5
13	7.7	63	5.1	113	4.3	163	3.9	213	3.7	263	3.5
14	7.5	64	5.0	114	4.3	164	3.9	214	3.7	264	3.5
15	7.4	65	5.0	115	4.3	165	3.9	215	3.7	265	3.5
16	7.2	66	5.0	116	4.3	166	3.9	216	3.7	266	3.5
17	7.1	67	5.0	117	4.3	167	3.9	217	3.7	267	3.5
18	7.0	68	5.0	118	4.3	168	3.9	218	3.7	268	3.5
19	6.9	69	4.9	119	4.3	169	3.9	219	3.7	269	3.5
20	6.8	70	4.9	120	4.3	170	3.9	220	3.6	270	3.5
21	6.7	71	4.9	121	4.3	171	3.9	221	3.6	271	3.5
22	6.7	72	4.9	122	4.3	172	3.9	222	3.6	272	3.4
23	6.6	73	4.9	123	4.2	173	3.9	223	3.6	273	3.4
24	6.5	74	4.9	124	4.2	174	3.9	224	3.6	274	3.4
25	6.4	75	4.8	125	4.2	175	3.9	225	3.6	275	3.4
26	6.4	76	4.8	126	4.2	176	3.9	226	3.6	276	3.4
27	6.3	77	4.8	127	4.2	177	3.9	227	3.6	277	3.4
28	6.3	78	4.8	128	4.2	178	3.9	228	3.6	278	3.4
29	6.2	79	4.8	129	4.2	179	3.8	229	3.6	279	3.4
30	6.1	80	4.8	130	4.2	180	3.8	230	3.6	280	3.4
31	6.1	81	4.7	131	4.2	181	3.8	231	3.6	281	3.4
32	6.0	82	4.7	132	4.2	182	3.8	232	3.6	282	3.4
33	6.0	83	4.7	133	4.2	183	3.8	233	3.6	283	3.4
34	5.9	84	4.7	134	4.2	184	3.8	234	3.6	284	3.4
35	5.9	85	4.7	135	4.1	185	3.8	235	3.6	285	3.4
36	5.9	86	4.7	136	4.1	186	3.8	236	3.6	286	3.4
37	5.8	87	4.6	137	4.1	187	3.8	237	3.6	287	3.4
38	5.8	88	4.6	138	4.1	188	3.8	238	3.6	288	3.4
39	5.7	89	4.6	139	4.1	189	3.8	239	3.6	289	3.4
40	5.7	90	4.6	140	4.1	190	3.8	240	3.6	290	3.4
41	5.7	91	4.6	141	4.1	191	3.8	241	3.6	291	3.4
42	5.6	92	4.6	142	4.1	192	3.8	242	3.6	292	3.4
43	5.6	93	4.6	143	4.1	193	3.8	243	3.6	293	3.4
44	5.6	94	4.6	144	4.1	194	3.8	244	3.5	294	3.4
45	5.5	95	4.5	145	4.1	195	3.8	245	3.5	295	3.4
46	5.5	96	4.5	146	4.1	196	3.8	246	3.5	296	3.4
47	5.5	97	4.5	147	4.1	197	3.8	247	3.5	297	3.4
48	5.4	98	4.5	148	4.0	198	3.7	248	3.5	298	3.4
49	5.4	99	4.5	149	4.0	199	3.7	249	3.5	299	3.4
50	5.4	100	4.5	150	4.0	200	3.7	250	3.5	300	3.4

Appendix B References

- [1] ENA EREC P25. *The short-circuit characteristics of single-phase and three-phase low voltage distribution networks*.2018.
- [2] ENA EREC P23. *Guidance on Earth Fault Loop Impedance at Customer's Intake Supply Terminals*. 2017.
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- [4] BS EN 61439-3:2012. *Low-voltage switchgear and controlgear assemblies. Distribution boards intended to be operated by ordinary persons (DB)*.
- [5] BS EN 60909-0:2016. *Short-circuit currents in three-phase a.c. systems. Calculation of currents*.
- [6] BS 7671:2008+A3:2015. *Requirements for Electrical Installations. IET Wiring Regulations (17th Edition)*.
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- [9] ENA EREC G87. *Guidelines for the Provision of Low Voltage Connections to Multiple Occupancy Buildings*. 2015.