Engineering Recommendation G81

Appendices to Parts 1, 2, 3, 4, 5 & 6

Framework for design and planning, materials specification and installation and records for:

Greenfield low voltage housing estate installations and associated new, HV/LV distribution substation

Industrial and Commercial underground connected loads up to and including 11kV

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Revision Log

Version: 6.0	Prepared by: Tony Haggis	Date: February 2007	
Re-branded to E.ON Central Networks.			
Version: 5.0	Prepared by: Tony Haggis	Date: September 2006	
Modified to include industrial & commercial loads up to 11kV. (appendices 4,5&6) Central Networks' Guidance for Civil Construction Requirements for New Distribution Substations now included in the list of reference documents.			
Version: 4.0	Prepared by: Tony Haggis	Date: November 2004	
Central Networks EAST & WEST documents consolidated into single G81 appendix.			
Version: 3.0	Prepared by: Tony Haggis	Date:	July 2004
Document re-badged Central Networks EAST Sections that are duplicated in the new Network Design Manual have been deleted.			
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3.1.2 Materials & Suppliers list updated 4.1 Renamed Test and Energisation requirements 4.1.1 Test requirements amended 4.1.2 Pre-energisation Network Connectivity Status Report added 4.2.1 Service position details moved from Design section 2.2.4			
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New document issued.			

IMPORTANT NOTE

The former Central Networks (CN) was acquired by Western Power Distribution (WPD) in April 2011. WPD G81 documents and processes will apply to future connections **with effect from 1st April 2012.** (see WPD website – www.westernpower.co.uk/New-Connections/Connections/Competition)

Independent Connection Providers and, as applicable Independent Distribution Network Operators currently in the process of making connections to the former CN systems should continue to use the CN suite of G81 documents –

- for connections where a point of connection has already been provided
- for connections where design approval has already been given
- for connections planned to be made in the period up to 31st March 2012

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1. INTRODUCTION

These Appendices serve to compliment the general provisions of Engineering Recommendation G81 and set out the minimum requirements for design of low voltage underground cable electricity networks, including their new associated HV/LV distribution substations, for Greenfield site housing estates and industrial & commercial loads up to 11kV undertaken under the Ofgem Competition in Connections regime.

The technical standards of Central Networks are currently split into:

- Central Networks East – formally East Midlands Electricity
- Central Networks West – formally Aquila/GPU/ Midlands Electricity

The Central Networks' Network Design Manual applies to the whole of Central Networks. Where technical differences exist between the two areas they are identified in the text.

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Until such time as the remaining technical standards and materials of the two former companies are rationalised, all construction work under the provisions of Engineering Recommendation G81 shall be carried out with reference to the following Central Networks EAST /East Midlands Electricity Manuals and Codes of Practice:

General and Technical Requirements for the Adoption of Networks by Central Networks
Central Networks' Network Design Manual
Central Networks' Guidance for Civil Construction Requirements for New Distribution Substations.
EME Cables, Cable Laying & Accessories Manual
EME Earthing Manual
EME Overhead Line Manual Volume 1 - LV to 33kV Specifications
EME Overhead Line Manual Volume 2 – Drawings & Reference Info.
EME Padmount Guide
EME Plant Specification Manual
EME Code of Practice for the Capture of Asset and Customer Data Records.
EME Code of Practice 14 HV Cable Jointing
EME Code of Practice 15 LV Cable Jointing

In the event of there being any conflict between Engineering Recommendation G81, these appendices and/or the Central Networks ' Manuals and Codes of Practice then the Central Networks' Manuals and Codes of Practice shall take precedence.

Central Networks will expect the Applicant to perform the work exercising all the skill, care and diligence to be expected of a competent practitioner experienced in distribution system design and construction work and in accordance with good and sound industry practice.

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2. Part 1 - Design and Planning

2.1 APPENDIX A Design Information – Data Required From Applicant

2.1.1 Information Required in Design Proposals

Contestable Design shall be carried out by the Customer or their Approved Contractor under the arrangements employed by Central Networks for a Customer seeking the Competition in Connection option. The following requirements must be met.

To approve a design submitted by a Customer or chosen Approved Contractor, Central Networks will require a detailed layout drawing of the proposed site at an acceptable scale (minimum 1:500). This should indicate the following information:

- The location and size of all substations, mains and service cables, earthing points and the preferred Point of Connection to the existing network.
- The voltage drop at the feeder end under design loading conditions.
- The phase connection of each connection point.
- Details of cable easements/wayleaves for cable routes not located in the Public Highway.

A written statement should also be provided with the following information included: -

- Voltage drop calculation and methods used e.g. ADMD.
- Harmonic considerations.
- Circuit loading and ratings.
- Maximum short-circuit currents.
- Design of earthing system including:
  Soil resistivity in ohm.metres and measurement method used
  Equipment Potential Rise – criteria for designating the site as a hot or cold
  Extent of 430 volt ground potential contour for a hot site
  Precautions taken against Touch, Step & Transferred potentials
- Correct operation and grading of protective devices.
- Compliance with security standards.

- Provision made for future load growth.

The above information is not exhaustive and Central Networks would reserve the right to request any further information deemed necessary to carry out the formal design approval process.

2.1.2. Point of Connection

In order for Central Networks to decide the Point of Connection to the existing distribution network the following information is required: -

- Site layout drawing showing adjacent road networks.
- Total site maximum demand requirements and anticipated time of demand in any 24-hour period. For large low or high voltage single connections the anticipated Load Factor must be provided.
- Proposed type of heating e.g. gas/electric/other.
- Details of any disturbing loads e.g. water pumping stations etc.
- Expected date of connection where applicable.

The Approved Contractor or Customer should discuss any other network considerations with Central Networks e.g. reinforcement or automation.

2.2 APPENDIX B Design Data Specific to Central Networks

Please refer to Central Networks' Network Design Manual.

3. Part 2 Materials Specification

3.1 APPENDIX A Materials Data Specific to Central Networks

3.1.1 Acceptability criteria

Materials to be adopted by Central Networks:

1. Must conform to a national, international or other standards acceptable to Central Networks

2. Must be manufactured to a quality standard acceptable to Central Networks.

3. Shall incur minimal environmental impact in the manufacturing / supply process.

4. The health and safety of the supplier's / manufacturers workforce must not be compromised.

5. Central Networks must not have had, or be aware of, unfavourable experience with the particular make or type of product.

Not all suppliers meet Central Networks' audit standards and as a result some are not permitted to supply materials that would otherwise meet relevant specifications.

3.1.2 Materials & Suppliers

The following list contains suppliers that have been audited and accepted by Central Networks. The Applicant may offer alternative suppliers and products provided the Applicant can demonstrate that the alternative meets or exceeds our standards.

The exact specifications for the materials are contained in Central Networks' Manuals which can be made available to the Applicant on request.

Materials & Suppliers		
Item	**Specification**	**Acceptable suppliers**
Compact Unit Substation	ENATS 35-1 ENATS 37-2 ENATS 41-36	Groupe Schneider, Merlin Gerin. Leeds Lucy Switchgear, Walton Well Rd, Oxford OX2 6EE
Substation Housings		Envico, Swansea Coe's, Derby
GRP Gratings		TW Engineering Co Ltd, Quarry Hill Ind Park, Ilkeston, Derbys. DE7 4RB
GRP Roofs and Doors		Stormking, Sandy way Tamworth, B77 4ED
Padmount Transformer	ANSI C57:12:26 ANSI C57:12:25	Cooper / Langley Engineering, Theale, Reading
Padmount Elbow Connectors	ANSI	Cooper / Langley Engineering, Theale, Reading Euromold / Nexan
Earth fault Indicators		Bowden Bros Nortech
Transformers	ENATS 35-1	ABB Transformers, Waterford, Ireland South Wales Transformers, Pauwels Trafo Ireland Ltd Dublin Road Cavan Areva, Transmission & Distribution, Stafford
Poles	BS 1991	Scanpole, Grimsby, DN41 8JD Calders & Grandidge, Boston Finforest, Newport, Gwent
Earth Rods and connectors	ENATS 43-94	W Furse - Nottingham Erico – Reading BB Price Ltd
Fuses (LV)	BS88 Part 5	Cooper Bussmann UK Ltd - Burton On Wold, Leics GEC Alsthom - Liverpool MEM - Tyseley, Birmingham Lawson Fuses
HV Cable	HD 620 IEC 60502	Pirelli, Wrexham Copper Cable Company, Coalville, Leics Tratos, Italy General Cable, Spain
LV Cable	BS 7870 Part 3.4	Prysmian, Wrexham Copper Cable Company, Coalville, Leics Tratos, Italy
Service cable	ENATS 09-07	Prysmian, Wrexham Copper Cable Company, Coalville, Leics

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Materials & Suppliers (continued)		
Item	**Specification**	**Acceptable suppliers**
HV Cable Joints	BS 7888	Tyco, Swindon Prysmian, Wrexham. 3M United Kingdom, Bedford
LV Cable Joints	BS 7888	Sicame Electrical Developments, Holmfirth, West Yorks Prysmian, Wrexham. Tyco, Swindon 3M United Kingdom, Bedford
Service Cut-outs		Lucy, Oxford WT Henley, Gravesend, Kent
Group Service Panels / Multi-way Cut-outs		Lucy, Oxford Bemco
Meter Boxes	ENATS 12-03	Jewsons Mitras, Biddulph Moor
Polythene Protection Tape / Tiles	ENATS 12-23	TW Engineering Centriforce Ltd
Ducts	ENATS 12-24	Polypipe Civils, Loughborough, Leicestershire Radius Plastics Ltd Emtelle, Hawick, Scotland, TD9 8LF
Duct sealing	Denso putty Hilti foam	Denso Hilti
Service Distribution Box		Sicame Electrical Developments, Holmfirth, West Yorks
LV Link Box		Tyco, Swindon Sicame Electrical Developments, Holmfirth, West Yorks Prysmian, Wrexham.
Operational Locks & labels		Operational locks, access locks, circuit designation and substation labels will be supplied and fitted by Central Networks.
Switchgear Automation		Where the Company require the RMU to be equipped for remote operation as part of an automation scheme, the third party will be advised at the planning stage. Technical details of the automated RMU specification will be provided by the Asset Manager in these circumstances.

4. Part 3 Installation and Records

4.1 APPENDIX A Test and Energisation Requirements

4.1.1 Test Requirements:

Please referee to Section 9 of the Network Design Manual

4.1.2 Pre-energisation Network Connectivity Status Report

No later than 2 working days before energisation the Applicant shall provide Central Networks with a written statement of the connectivity status of the network to be energised together with as-installed drawings as required in section 4.3.1 APPENDIX B Asset Recording

The status report shall show

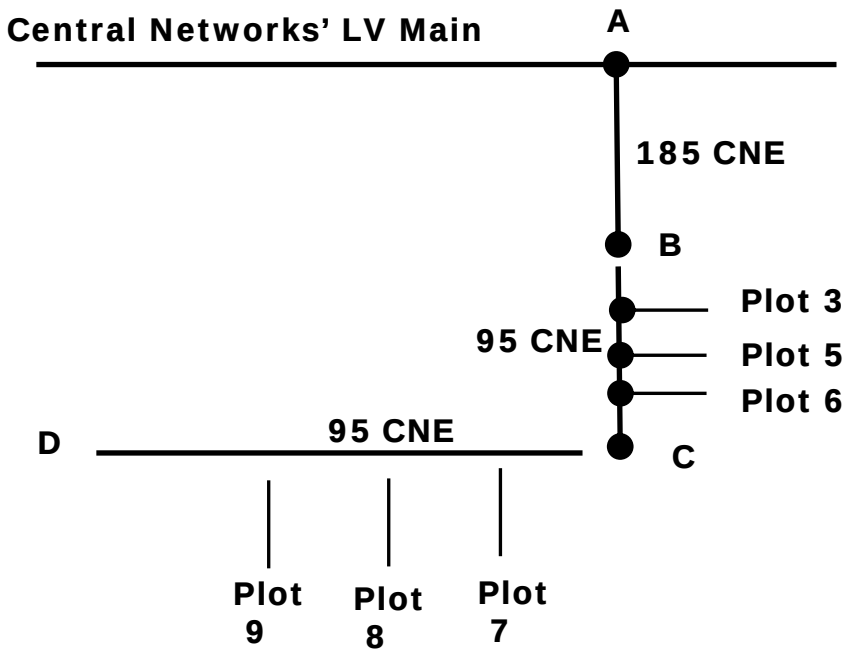
The cables and equipment previously energised
The cables and equipment to be energised on this occasion
The cables and equipment already installed on site but NOT to be energised on this occasion.

The report shall comprise of:

- A list of cables and equipment together with a schematic drawing marked up alphabetically to cross reference the cable sections to the list.
- A of the copy of the as-laid drawing marked up alphabetically to cross reference the cable sections to the list.

An example of an acceptable format of the list and schematic drawing is shown over the page:

Plan reference	**Description of cable / joint / substation etc.**	**Organisation responsible**	**Connectivity Status** e.g. Already LIVE, Ready to Make Live To remain DEAD
A	Breech joint onto DNO main	Central Networks	Already LIVE,
A- B	185 CNE cable to bottle end	Cable Layer Co Ltd	Already LIVE,
B	185 to 95 CNE straight joint	Central Networks	to energise next section B-C
B-C	95 CNE cable	Cable Layer Co Ltd	Cable laid
C	95 Bottle end	A Jointer Co Ltd	Ready to make live
B-C	Services to plots 3, 5 & 6	A Jointer Co Ltd	Ready to make live
C-D	95 CNE cable	Cable Layer Co Ltd	Cable laid To remain DEAD
C-D	Service cables to plots 7, 8 & 9	Cable Layer Co Ltd	Cables laid To remain DEAD
C-D	Bottle end at D and Services to plots 7, 8 & 9	A Jointer Co Ltd	Not jointed yet To remain DEAD



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4.2 APPENDIX A Installation Requirements

4.2.1 Service entries

Service terminations shall be in accordance with the Central Networks' Network Design Manual.

4.2.2 Cable laying

Cables shall be installed in accordance with the 'Technical Requirements for Cable Laying' section of the EME Cables, Cable Laying & Accessories Manual. This document includes details such as cable depths, spacing, bending radii, pulling tensions etc. for our standards sizes of LV, 11kV & 33kV cables.

4.2.3 Earthing

Earthing shall be designed and installed in accordance with the EME Earthing Manual.

4.2.4 LV Jointing

The EME Code of Practice 15 LV Jointing contains examples of LV cable joints and jointing procedures acceptable to Central Networks. The cable joints and method statements offered by the Applicant will be evaluated against this Code of Practice.

LV joints and terminations shall normally be made 'colour true'.

Much of Central Networks' LV network runs at National Standard phasing. However, some isolated parts of the LV network may have non-standard phase rotation or may be 30 degrees displaced from National Standard due to historical crosses on the local HV system. There are also many instances of HV & LV cores being crossed and/or rolled between switchgear, transformer and LV feeder pillar in existing substations.

Where the project requires LV interconnection it may be necessary to cross the LV connections in the substation LV feeder pillar. Where a local 30 degree displacement exists the HV busbars of the substation may have to be commissioned non-standard. The Applicant should seek advice from Central Networks in these cases.

4.2.5 HV Jointing

The EME Code of Practice 14 HV Jointing contains examples of 33kV & 11kV cable joints and jointing procedures acceptable to Central Networks. The cable joints and method statements offered by the Applicant will be evaluated against this Code of Practice.

The busbars of new HV plant will normally be commissioned to National Standard except where local historical phasing conditions preclude this. Most projects will require that a National Standard reference be established at an adjacent substation prior to jointing in the new substation. The Applicant should seek advice from Central Networks in all cases.

HV cable terminations shall not be physically crossed inside cable boxes under any circumstances. The correct phasing of the busbars shall be established by crossing cores in joints where necessary.

The colour conventions commonly encountered in Central Networks include, but are not limited to:

National Standard	Plant			New cables			Examples of local historical colours	
	HV	LV	HV or LV	Core Number	British Standard	Harmonised European Standard	PILSTA PILSWA	Leicester plain lead cables
L1	A	a	U	1	Red	Brown	Red	Brown
L3	B	b	V	2	Yellow	Black	Yellow or White	Green
L3	C	c	W	3	Blue	Grey	Blue	Red
N		n	N	0	Black	Blue	Green or Black	Blue

The Applicant must not assume that any marking on cables or plant represent National Standard phases. *Significant parts of Central Networks system has non-standard phasing as a legacy of individual electric power undertaking's local standards inherited at nationalisation in 1947.*

4.2.6 Substations and Pole Transformers

The EME Plant Specification Manual includes details of the range of standard plant as installed by our staff and contractors. The Applicant's proposals will be evaluated against this Manual.

Civil work specifications are contained in the Central Networks' Guidance for Civil Construction Requirements for New Distribution Substations.

The following sections of the Central Networks' Network Design Manual specify the type and location of substations and pole transformers:

1.2.10 Transformers Supplying LV Networks

1.4.7 Physical Siting of 11kV Substations, Cables and Lines

Central Networks may require the Applicant to provide documented quantified risk assessments for individual sites.

Statutory Substation Danger Notices, Signs, Switchgear Labels and Operational Locks shall be provided and fitted by Central Networks. This work will be deemed Non-Contestable and appropriate charges will be made under the Construction and Adoption Agreement.

4.3 APPENDIX B Asset Recording

4.3.1 Code of Practice for the Capture of Asset and Customer Data Records

For detailed information refer to the Central Networks EAST "Code of Practice for the Capture of Asset and Customer Data Records".

For detailed information refer to Central Networks WEST "Requirements specification for the supply of Secondary system site data records to Network Data Services".