Electricity Specification 230

Issue 1 June 2019

Connection of Low Carbon Technologies

Contents

Approved for issue by the Technical Policy Panel

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Issue and Amendment Summary

Amendment No. Date	Brief Description and Amending Action
0 14/6/19	Issue 1 First Issue. Prepared by: P. Twomey Authorised by: Steve Cox Engineering & Technical Director

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CONNECTION OF LOW CARBON TECHNOLOGIES

1. INTRODUCTION

Increasing numbers of Low Caron Technologies (LCTs) such as Electric Vehicle Charge Points (EVCPs) are being connected to the Electricity North West Limited (Electricity North West). The uptake of LCTs is expected to increase in line with the national transition to electrification of heat and transport. Other LCTs include Heat Pumps (HPs) and inverter connected micro-generation. Standard connection arrangements and assessment techniques are required, in order to ensure adequate safety and security for both EVCP users and the public. By applying these standards, Electricity North West Limited expects installations, which it adopts, to comply with the Electricity Safety, Quality and Continuity Regulations 2002 as amended (ESQCR) and to facilitate compliance with the Electricity at Work Regulations 1989.

2. SCOPE

This Electricity Specification (ES) details the requirements for new connections of LCTs directly connected to the Electricity North West electricity distribution network. The connection of the new LCTs may be to either an existing or new exit point. This ES covers connections, which are intended for adoption by Electricity North West, installed both by itself and by Independent Connection Providers.

3. DEFINITIONS

Al	Aluminium conductor
BS	British Standard
CNE	Combined Neutral and Earth - 3-core waveform and Consac are typical CNE cable types.
Network	The electricity distribution network owned and operated by Electricity North West.
PME	Protective Multiple Earthing. This refers to the technique of using the Supply Neutral Conductor of the LV Network to provide earthing facilities for customers.
TT	A system having one point of the source of energy directly earthed, the exposed-conductive parts of the installation being connected to earth electrodes electrically independent of the earthed electrodes of the source.

4. GENERAL

4.1 Any variation to this specification shall be agreed, in writing, with the Planning Policy Manager, Network Strategy directorate, Electricity North West prior to any design being accepted.

4.2 The Owner's Works shall comply with the requirements of BS 7671 Requirements for Electrical Installations.

4.3 It is a requirement that all work shall be carried out strictly in accordance with the provisions of all relevant legislation and industry best practice.

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4.4 Design principles in EPD283 shall apply.

4.5 This document shall be read in conjunction with BS 7671 and the IET Code of Practice for Electric Vehicle Charging Equipment Installation.

5. CONNECTION ARRANGEMENTS

5.1 Domestic Heat Pumps and Electric Vehicles Charge Points

5.1.1 Connections shall be in accordance with the Energy Networks Association (ENA) process. This process allows connections to proceed without application if specific conditions are met, otherwise an application is required. The process includes a decision tree to assist installers with this decision, with links to third party websites such as Meter Operation Code Of Practice Agreement (MOCOPA) to provide further information. The process is described in Appendix A, and the application form in Appendix B.

5.1.2 EVCP installers shall ensure that their installation comply with BS 7671 and the IET Code of Practice for Electric Vehicle Charging Equipment Installation.. In particular they are responsible for ensuring the safe design and installation of the earth system.

5.1.3 For multiple installations, diversity shall be determined using Engineering Recommendation (EREC) P5.

5.1.4 Installers shall email notifications to SSEGG831@enwl.co.uk . Details of all installations shall be recorded in the DG Database, and marked up on mains records as per CP625.

5.2 Public EVCPs

5.2.1 New connections shall be compliant with the IET Code of Practice for Electric Vehicle Charging Equipment Installation.

5.2.2 Earthing systems shall be TT and in accordance with CP332. Due regard shall be given to the proximity of other earthing systems, including other Class 1 street furniture and earthed steel structures, to avoid hand to hand touch voltages. Current practice requires a minimum 2.5 meter separation between TT and TN-C-S (PME) earthing systems.

5.2.3 The installer shall be responsible for ensuring connections are fully compliant with the requirements of BS 7671.

5.2.4 Installations shall be compliant with the requirements of ES211 and ES212. Electricity North West's Cut-out may be located in the EVCP providing that it is accessible, and installation, repair, alteration and disconnection of the connection may be carried out without causing a safety hazard or an obstruction. In each case, a risk assessment shall be carried out, taking into account the expected life of the installation.

5.2.5 A diversity factor of 0.8 shall be applied to EVCP located in public locations.

5.3 EVCPs at Multi-Occupancy Buildings

5.3.1 Electricity North West's preferred arrangement is for the EVCP supply to be derived from the building's main supply.

5.3.2 Where the arrangement in 4.3.1 is impractical or significantly uneconomic, a second supply may be provided if all the following conditions can be met.

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- There is adequate separation between the earth electrodes of the EVCP and existing earthed structures. This is dependent on local soil resistivity conditions, however it is up to the EVCP installer to determine this distance.
- There is at least 2.5 metres separation between metallic structures above ground connected to the TT earth and structures connected to the earth of the existing supply.
- Likelihood of interconnection is assessed as negligible
- The EVCP is labelled

Danger – Isolate supply to EV Charger separately from main building

5.3.3 Diversity shall be:

- As EREC P5 where every parking bay has an EVCP
- 0.8 where there are fewer EVCPs than parking bays

5.4 EVCPs at private locations managed by third parties

5.4.1 EVCPs at private locations used by the public are becoming increasingly common. Examples include EVCPs in pub car parks, hotel car parks, motorway service stations.

5.4.2 The same principles in subsection 4.3 apply.

5.4.3 A second supply may be provided if all of the following conditions can be met.

- There is adequate separation between the earth electrodes of the EVCP and existing earthed structures. This is dependent on local soil resistivity conditions, however it is up to the EVCP installer to determine this distance.
- There is at least 2 metres separation between metallic structures above ground connected to the TT earth and structures connected to the earth of the existing supply.
- Likelihood of interconnection is assessed as negligible
- The EVCP is labelled

Danger – Isolate supply to EV Charger separately from main building

5.4.4 Diversity shall be 0.8.

5.5 Micro-generation and domestic storage

5.5.1 Domestic micro-generation and storage shall be connected in accordance with CP259 and ES259.

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5.5.2 Special connection arrangements exist for Installations comprising two fully type tested EREC G98 Micro-generators controlled by an EREC G100 compliant export limitation device. If the export is limited to 16A per phase, customers may apply to connect using a 'fast track' process. The detail and requirements of this process are given in Appendix D.

5.5.3 The fast track process is not appropriate for installations not meeting the requirements of 4.4.2, these shall be assessed under EREC G99.

5.6 Power Quality Assessment

5.6.1. HP connections assessments shall usually be based on equipment compliance with

- BS EN 61000-3-2 Limits for harmonic current emissions (equipment input current <= 16A per phase)
- BS EN 61000-3-3 Limitations of voltage changes, voltage fluctuations and flicker in public low voltage supply systems – equipment with rated current <16A
- BS EN 61000-3-11 Limitations of voltage changes, voltage fluctuations and flicker in public low voltage supply systems – equipment with rated current <75A and subject to conditional connection
- BS EN 61000-3-12 Limits for harmonic currents produced by equipment connected to public low voltage systems with input current >16A and <75A

Manufacturers state compliance against these standards using a Declaration of Conformity. These Declarations are held on an ENA online database, together with any supporting test documentation. The data base is located on the ENA website http://www.energynetworks.org/electricity/futures/electric-vehicles-and-heat-pumps.html

Connections based on stated compliance with BS EN 61000-3-11 are conditional connections, and installers are required to state the maximum allowable source impedance $Z_{max.}$ Installers shall state compliance and Z_{max} using the form in Appendix C.

Connections based on stated compliance with BS EN 61000-3-12 are conditional connections, and installers are required to state the minimum allowable short circuit power $S_{sc.}$

5.6.2 Equipment not compliant with the standards above may be assessed against EREC G5 and EREC P28. Additional information will be required to enable such assessments. This is also detailed in the form in Appendix C.

5.6.2 The combined emissions from multiple EVCPs connecting to the same local network shall be summated using this formula:

$$U_h = \sqrt[\alpha]{\sum_i \left(U_{hi}^{\alpha}\right)}$$

A	Harmonic order
1	h < 5
1.4	5 ≤ h ≤ 10
2	H > 10

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Source: Extract from IEC 61000-3-6 Table 5

5.6.4 The assessment process for EVCP shall be based on EREC G5/4 using harmonic current emission data supplied by the installer or manufacturer. Initial assessments shall be Stage 1 and assume background harmonic levels. Connections failing the Stage 1 may progress to Stage 2. This is a more detailed assessment and requires a measurement of background levels.

The process is described in fully in Appendix E.

5.6.5 Summation of calculated harmonic voltage distortion to existing background shall be in accordance with equation 3 in EREC G5/4.

$$V_{hc} = \frac{I_h k h \sqrt{3} V_s 100\%}{F 10^6}$$

I_h = harmonic current (amps)

K = resonant factor from EREC G5/4

V_s = nominal system line voltage

F = system short circuit level at the point of common coupling (MVA)

H = harmonic order

V_{hc} = calculated harmonic distortion associated with the new load expressed as a % of the line voltage at the point of common coupling

Summation of individual harmonic voltages and pass/fail criteria shall be in accordance with EREC G5/4.

6. EQUIPMENT RECORDS

The Installer shall provide records of all services installed, using Form C of ES210 and marked upon the latest available edition of the Ordnance Survey map for the area, at 1/500 scale with any relevant detail shown on 1/250 enlargements. The colour codes and symbols to be used for marking shall comply with CP012.

HP and EVCP installations shall be shown on mains records as per CP012.

7. DOCUMENTATION

Documentation, ie Health and Safety File, operating manuals and commissioning test results, shall be as described in ES210.

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8. DOCUMENTS REFERENCED

8.1 Non - Electricity North West documents

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The Electricity Safety, Quality and Continuity Regulations 2002 as amended (ESQCR)

The Electricity at Work Regulations 1989

Meter Operators' Code of Practice Agreement (MOCoPA)

IET Code of Practice for Electric Vehicle Charging Equipment Installation.

BS 7671	Requirements for Electrical Installations (IET Wiring Regulations)
BS EN 61000-3-2	Limits for harmonic current emissions (equipment input current <= 16A per phase)
BS EN 61000-3-3	Limitations of voltage changes, voltage fluctuations and flicker in public low voltage supply systems – equipment with rated current <16A
BS EN 61000-3-11	Limitations of voltage changes, voltage fluctuations and flicker in public low voltage supply systems – equipment with rated current <75A and subject to conditional connection
BS EN 61000-3-12	Limits for harmonic currents produced by equipment connected to public low voltage systems with input current >16A and <75A

8.2 Electricity North West documents

EPD332	Customer Installation Earthing
EPD333	Supply System Earthing
CP012	Electricity Geographical Information System (GIS)
ES210	General Specification for Third Party Constructed New Connections, Extensions and Alterations
ES332	100 A House Service Cut-Outs

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9. KEYWORDS

Connection; cut-out; earth; fuse; meter; PME; service.

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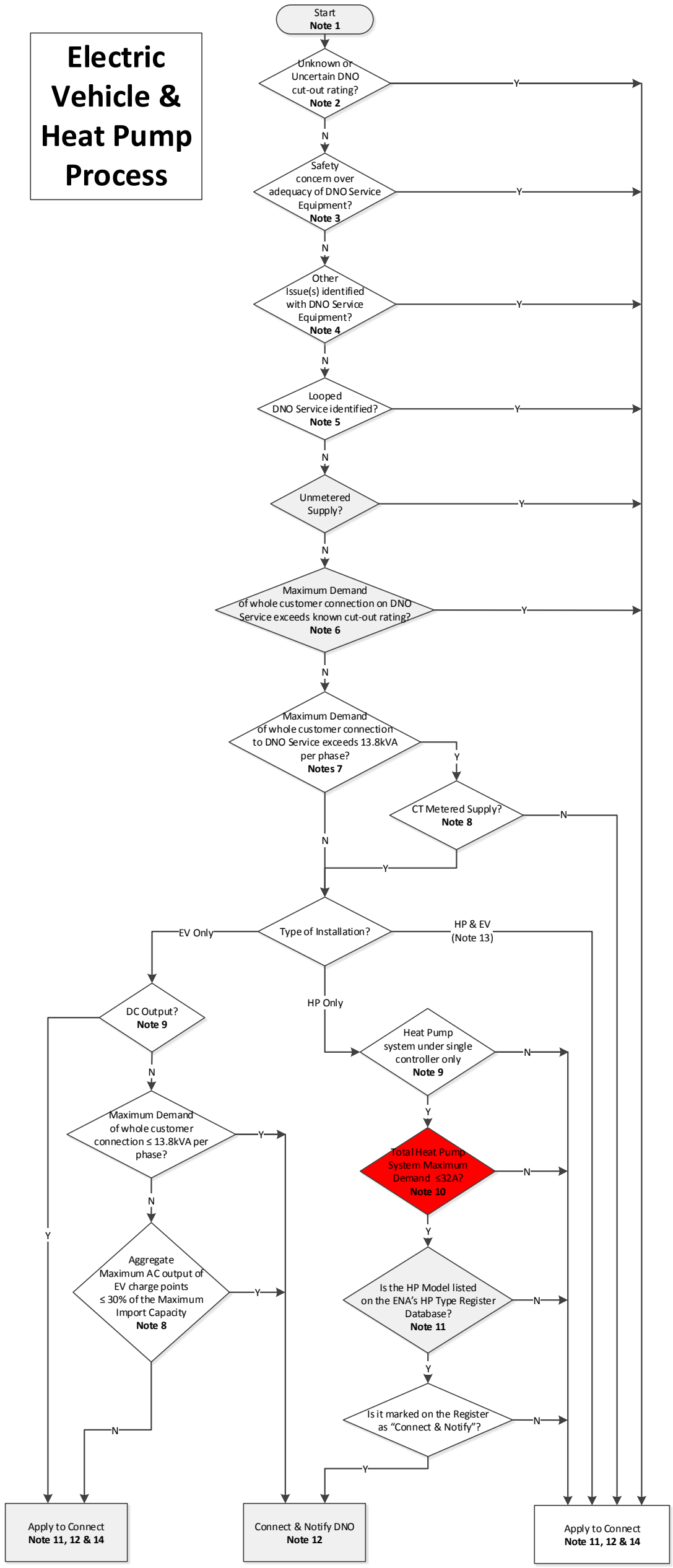
APPENDIX A

COMBINED HEAT PUMP AND ELECTRIC VEHICLE CONNECTION PROCESS

Electric Vehicle & Heat Pump Process



Note 1: This process should be used for premises with an existing DNO connection. For new DNO connections, this process should be followed in addition to a new electricity connection application.

DNO Service Equipment comprises DNO service cable, DNO cut-out (service head) and DNO earth terminal.

Note 2: If the cut-out rating is unknown or uncertain, it can be established by raising an enquiry with the DNO. If the supply capacity still cannot be established, the 'Apply to Connect' process must be followed. Please note that the cut-out should not be opened. Guidance on cut-out ratings is available on the ENA website.

The rating of the DNO service equipment must be established as adequate. BS 7671 – the Wiring Regulations – gives 132-16 'Additions or alterations to an installation': 'No addition or alteration, temporary or permanent, shall be made to an existing installation, unless it has been ascertained that the rating and condition of any existing equipment, **including that of the distributor**, will be adequate for the altered circumstances.'

Note 3: Safety concern over adequacy of DNO Service Equipment
Safety concerns over adequacy of DNO Service Equipment should be reported to the DNO in accordance with the MOCOPA Service Termination Issues Guidance available on the MOCOPA website: https://mocopa.org.uk/wp-content/uploads/2018/03/MOCOPA-guide-version-3.5.pdf

The guide gives specific examples of issues that can give rise to danger, classified as "Category A Situations", and how these should be reported to the DNO. All emergency issues (Category A Situations) must be reported to the DNO using telephone number 105 (GB only).

Note 4: Other Issue(s) identified with DNO Service Equipment
Other issues with DNO equipment that do not necessarily give rise to danger are described in the MOCOPA Service Termination Issues Guide: https://mocopa.org.uk/wp-content/uploads/2018/03/MOCOPA-guide-version-3.5.pdf

These issues are covered in the Category B and Category C Situations sections of the guidance document where specific examples are given of what is reportable to the DNO. All Category B and Category C Situations (non-emergency issues) should be reported to the DNO using their general enquiries number found on the customer's bill or online.

Note 5: Some DNO cut-outs have more than one DNO service cable terminated in the DNO cut-out. Such a situation indicates a 'Looped Service' where there are one or more services connected via the cut-out. Note this may impact on the adequacy of the DNO Service Equipment. Looped services can be found anywhere, but are often found in rural areas and terraced housing.

Note 6: Maximum Demand is the highest level of new demand that could occur on the whole customer connection, and includes all new HP and EV devices. The maximum cut-out rating may be visible on the cut-out. Ratings below 60A are possible (e.g. 30A, 40A and 45A), especially in rural areas. Note that the cut-out rating will be reduced from its stated value if the ambient temperature at the cut-out location is high e.g. due to inadequate ventilation, adjacent heat sources etc.

Note 7: IET Guidance Note 1, Appendix H gives qualified electricians guidance on the assessment of Maximum Demand for the whole customer connection.

Note 8: CT Metering is typically any meter rated at over 100A. This rating should be found on the meter name plate. CT metered installations are typically subject to a Maximum Import Capacity (also known as Agreed Supply Capacity).

Note 9: Multiple heat pump systems or DC Electric Vehicle charge point installations must be 'Apply to Connect.'

This means a single heat pump system under a single controller (but potentially with multiple devices) being installed in one property in isolation, as opposed to a cluster of separate heat pumps in the same or adjacent properties.

Note 10: Including any additional components i.e. boost, back-up or immersion heaters. A boost heater is a Direct Electric Resistance (DER) heater to supplement heat output when the HP cannot provide the necessary heat located in the primary heating circuit. A water heater/immersion heater is a DER heater located in the sanitary hot water cylinder and used to top up heat or pasteurise for legionella control. A back-up heater is a DER heater that is capable of replacing all or some of the heat output from the heat pump in the event of the heat pump not being operational. This would be positioned in the primary heating circuit.

Note 11: Please see ENA HP Type Register Database on the ENA website here: http://www.energynetworks.org/electricity/futures/electric-vehicles-and-heat-pumps.html It is the installers responsibility to provide all information required to populate the Heat Pump Type Register Database, as well as ensure any existing information within the Database is correct.

If the heat pump is not registered you must gather all of the required information and submit to ENA for inclusion in the Database.

NB: the Register is not an endorsement or recommendation of a particular heat pump model but is a means of simplifying the application and connection process.

Note 12: Please note that to ensure you comply with GDPR requirements, applications and notifications should only be sent to the relevant DNO that corresponds to the MPAN.

Note 13: With combined Heat Pump and Electric Vehicle Charge Point installations, the DNO will need to consider the Power Quality implications, and hence one must 'Apply to Connect.'

Note 14: Depending on the size and/or number of devices being connected, the DNO may ask for additional information to be supplied.

Where the maximum demand of the whole customer connection is less than 23kVA, the DNO will respond within ten working days, assuming the complete set of required information has been provided.

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APPENDIX B DEVICE POWER QUALITY DATA (ESSENTIAL)

Note: The manufacturer may need to be consulted to complete this technical data.

Device details	**Manufacturer**	
	Type reference	

EC Declaration of Conformity	Attach the manufacturer's EC Declaration of Conformity as produced in association with the EMC Directive	Attached? Yes/No?

Power Quality. Harmonics. This information should be provided by the manufacturer of a Device whose tests should be carried out as specified in BS EN 61000-3-12. Note that this is equivalent to IEC 61000-3-12.

Manufacturer states Device meets technical requirements of EN/IEC 61000-3-2? Note: Where the Device meets the technical requirements of BS EN/IEC 61000-3-2 then there is no need to complete the rest of this table.	Yes/No
Manufacturer states Device complying with EN/IEC 61000-3-12?	Yes/No
Manufacturer states Device complies with EN/IEC 61000-3-12 provided that the short-circuit power Ssc is greater than or equal to xx. If yes then complete S_{sc} value below.	Yes/No

State minimum 3-phase supply short circuit level, S_{sc}, required to allow connection under EN 61000-3-12					kVA
Rated Current, I_{equ}			A	Limit in EN 61000-3-12	
Reference Current, I_{ref}			A		
Operating Voltage (V):			V		
Phases			1 or 3		
Harmonic	Measured current (A)	Current as % of I_{ref}		1 phase (Ih/I_{ref})	3 phase balanced (Ih/I_{ref})
2				8%	8%
3				21.6%	Not stated
4				4%	4%
5				10.7%	10.7%
6				2.67%	2.67%
7				7.2%	7.2%
8				2%	2%
9				3.8%	8%
10				1.6%	1.6%
11				3.1%	3.1%
12				1.33%	1.33%
13				2%	2%
THC				23% of I_{ref}	13% of I_{ref}
PWHC				23% of I_{ref}	22% of I_{ref}

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Harmonic Emissions (Complete When BS EN 61000-3-12 Or -2 Do Not Apply)					
Rated Current (A)	……				
Operating Voltage[1] (V)	……				
Maximum Value Of Harmonic Currents For Each Harmonic Order					
Harmonic Order 'H'	Emission Current (A)	Harmonic Order 'H'	Emission Current (A)	Harmonic Order 'H'	Emission Current (A)
2	……	20	……	38	……
3	……	21	……	39	……
4	……	22	……	40	……
5	……	23	……	41	……
6	……	24	……	42	……
7	……	25	……	43	……
8	……	26	……	44	……
9	……	27	……	45	……
10	……	28	……	46	……
11	……	29	……	47	……
12	……	30	……	48	……
13	……	31	……	49	……
14	……	32	……	50	……
15	……	33	……		
16	……	34	……		
17	……	35	……		
18	……	36	……		
19	……	37	……		

[1] Note that where the customer has a Point of Common Coupling (PCC) above LV then the quoted currents should relate to the voltage at the PCC. In such a case, where the equipment is a source of DC injection then it may be necessary to determine the values at a PCC after modelling to allow for effect of transformer saturation with elevated harmonic currents. NB PCC is defined as the point in the public electricity distribution system electrically nearest to the Customer's installation at which other customers are, or may be, connected.

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Power Quality. Voltage fluctuations and Flicker. The tests/calculations should be carried out by the heat pump manufacturer or their designate, with typical worst case cycling on and off. The results should be normalised to the standard source impedance Zref, if this results in figures above the limits set in EN 61000-3-3 then a suitable Maximum source Impedance Zmax should be identified as required by EN 61000-3-11.	
Manufacturer states Device meets technical requirements of EN/IEC 61000-3-3? Note: Where the Device meets the technical requirements of BS EN/IEC 61000-3-3 then there is no need to complete the rest of this table.	Yes/No
Manufacturer states Device complying with EN/IEC 61000-3-11 provided that the source impedance is no more than Z_{max}?	Yes/No
Manufacturer states Device complying with BS EN/IEC 61000-3-11 provided that service current capacity ≥100A per phase?	Yes/No

	d_{max}	d_c	d(t)	T_{max} (8 new)	P_{st}	P_{lt} 2 hours
Measured Values at test impedance						
Normalised to standard impedance						
Normalised to required maximum impedance						
Limits set under BS EN 61000-3-11 & 61000-3-3	4%	3.3%	3.3%	500ms	1.0	0.65
Z test	R		ohms	X		ohms
Z ref	R	0.24 * 0.4 ^ 0.48 #	ohms	X	0.15 * 0.25 ^ 0.3 #	ohms
Z max	R		ohms	X		ohms

8 T max applied to comply with new revision

* Applies to three phase Devices

^ Applies to single phase Devices

Applies to interphase connected Devices using two phases on a three phase system

Note: Z_{max} must take account of multiple devices using the scaling down detailed in EN 61000-3-11 Section 6.2.2.

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APPENDIX C

Combined Generation and Storage Application (Formerly G59 Fast Track)

Contact Details		
Site MPAN		
Installer contact and qualification details	Generation unit:-	
	Storage Unit:-	
Generation owner details (if different)		
How many sites are you applying for?	1	More than 1
Total aggregated capacity of units including the capacity of the storage unit	Between 16A and 32A	Higher than 32A
Are you installing the equipment to limit your export capacity to 16A / phase (3.66kW)?	Yes	No
Will you be installing a G100 compliant export limiting scheme?	Yes	No
Will all your generating units (including storage units) be connected via G83 type tested inverters?	Yes	No
Will generator operate in island mode	No	Yes
Please provide the following: • Distributed Energy Resources (DER) technology / primary energy source • DER Capacity by technology • Inverter capacity by technology • G83 type test inverter reference number	Total DER capacity (limited by inverter where appropriate) ≤ 32A / phase and all units G83 type tested (upload type test certificates) where this is provided proceed...where not follow G59 route	
Please provide details of your export limiting scheme: • G100 compliance declaration • Maximum export setting	Provided	Not provided
Please provide schematic diagram for the proposed scheme	Provided	Not provided
Connection route	**Use G59 Fast Track**	**Use standard G59**
What is your planned commissioning date?	Must be at least 10 working days[1] from date of application but not more than 3 months in advance (our connection offers are only valid for 3 months) Applicants must return commissioning sheets within 28 days of commissioning	

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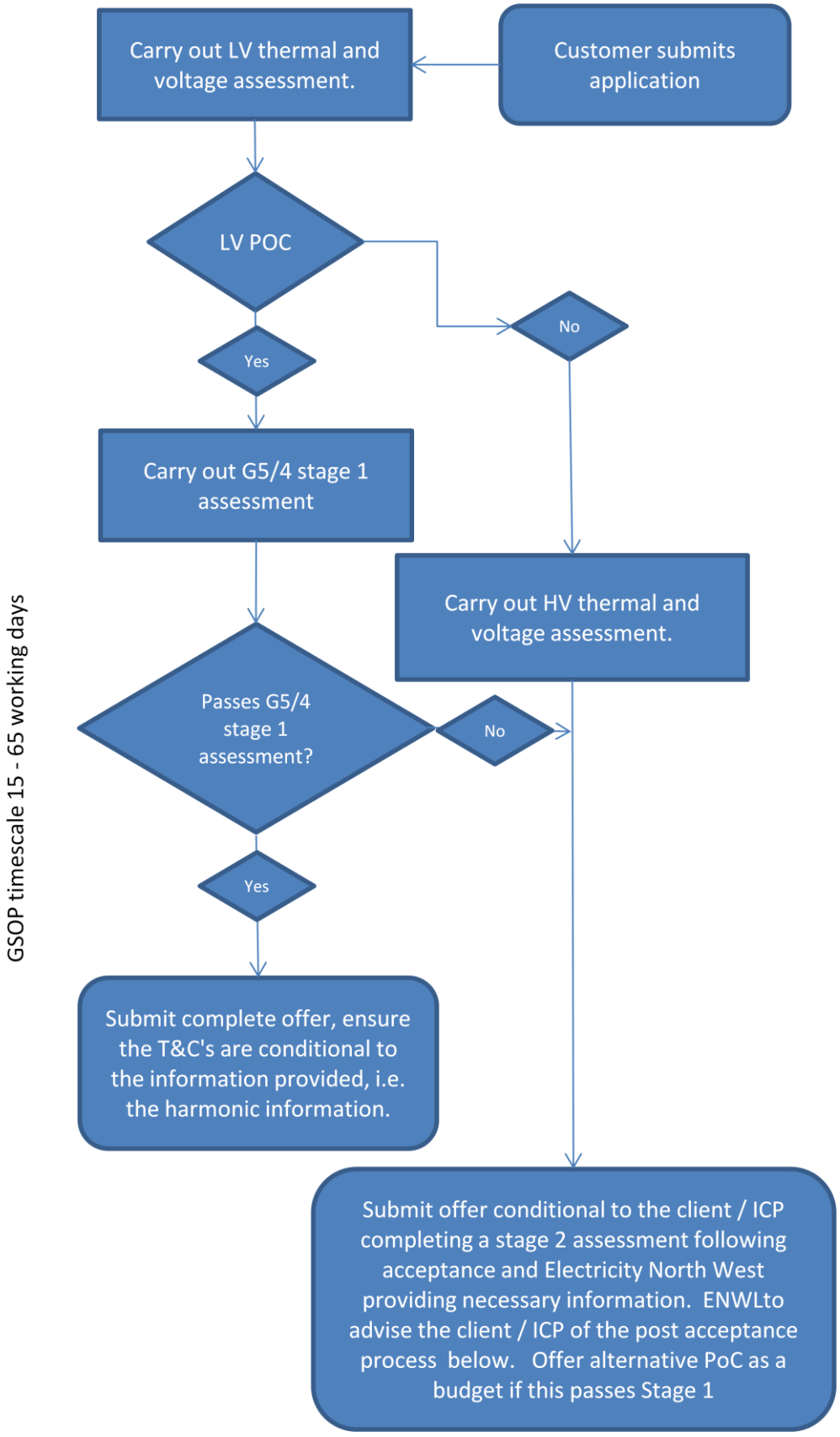
APPENDIX D EVCP CONNECTION PROCEDURE



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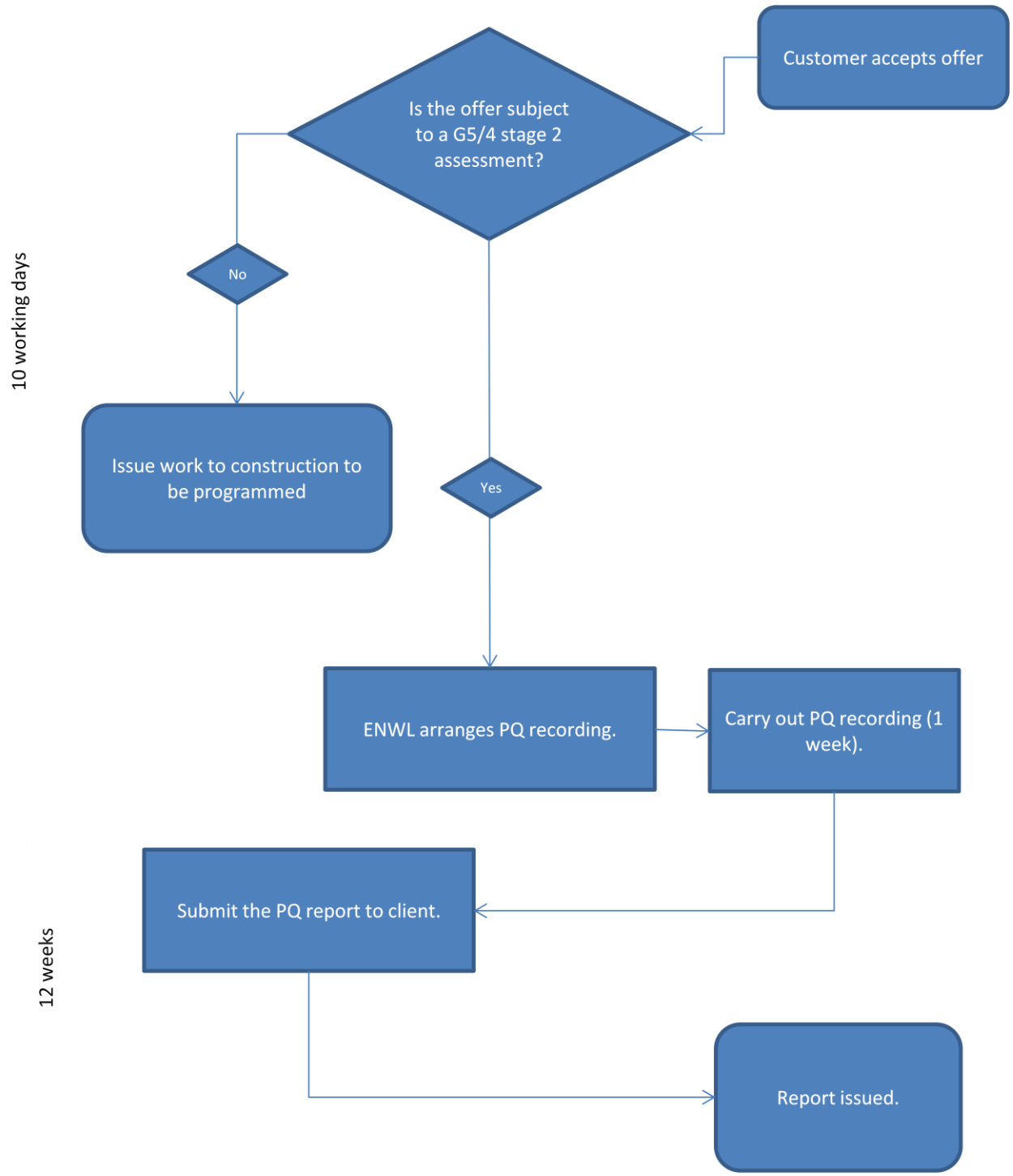

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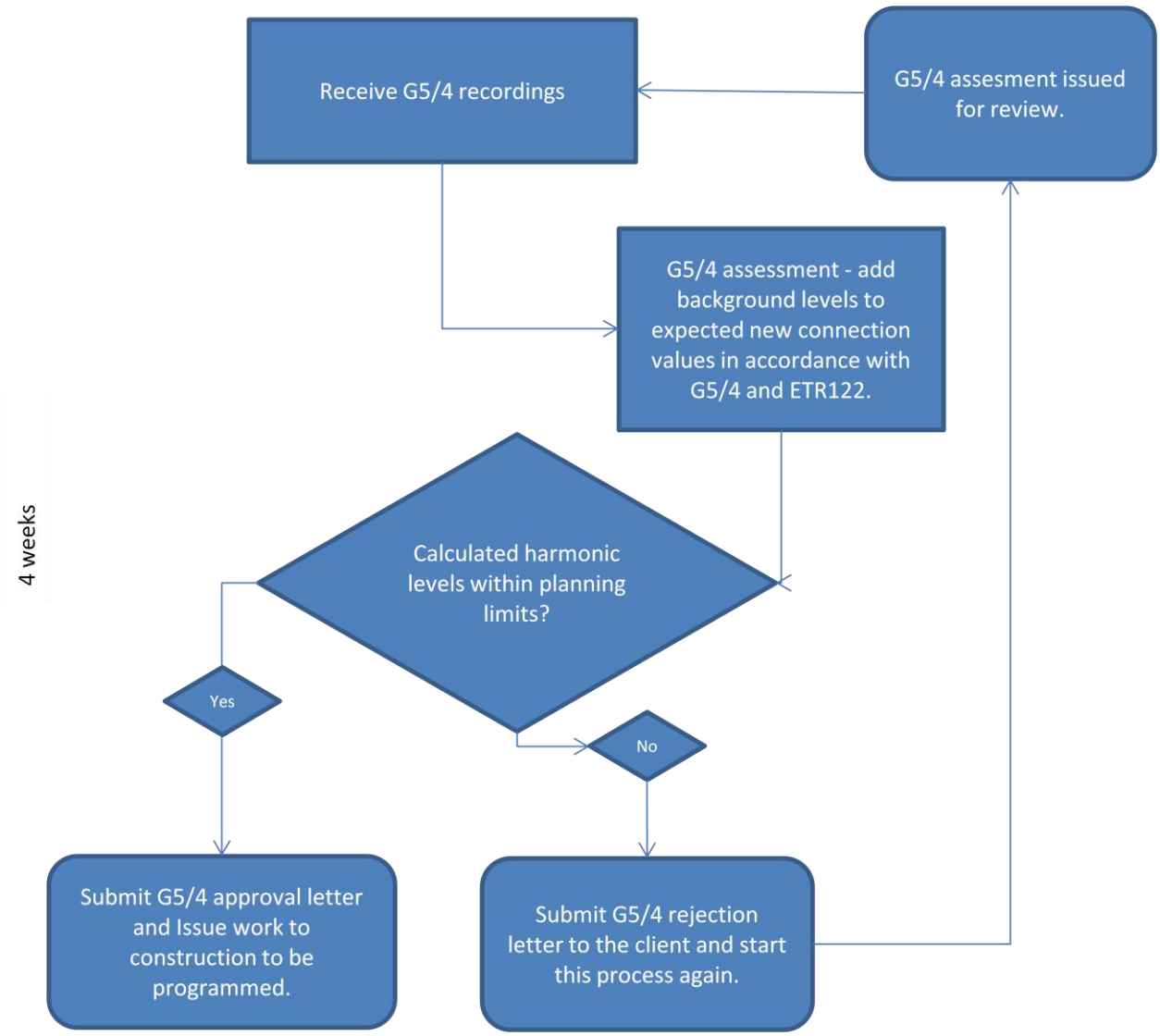

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