Electricity Specification 357

Issue 1 **March 2013**

Monitoring Installations for use on the LV Cable Network

Contents

Approved for issue by the Technical Policy Panel

Issue and Amendment Summary

Amendment No. Date	Brief Description and Amending Action
0 01/03/13	Issue 1 First Issue Prepared by: G M Bryson Approved by the Technical Policy Panel and signed on its behalf by Paul Whittaker:

MONITORING INSTALLATIONS FOR USE ON THE LOW VOLTAGE CABLE NETWORK

1. INTRODUCTION

This specification describes the general and technical requirements for the provision of monitoring installations for use on the Low Voltage cable network in Electricity North West Limited, hereinafter referred to as Electricity North West.

The chosen monitoring installations will be deployed at sites on the Electricity North West Low Voltage (LV) underground cable network. It is anticipated that the current sensors deployed will be of the Rogowski coil type or similar and the system voltage will be obtained through a three phase jointing accessory.

The installation shall be capable of providing, processing and manipulating analogue and digital data for collection, storage and transmission as required. These installations will complement the existing substation and overhead monitoring units currently being deployed on the Electricity North West LV network and will need to mirror and complement the data being provided by these monitoring units.

2. BACKGROUND

As the UK economy moves towards a low carbon future the effects on the distribution networks will be varied. It is expected that demand for electricity will rise as transportation is decarbonised by electric vehicles. Further demand will result from the electrification of heating in the form of heat pumps, which are expected to replace increasingly expensive oil-fuelled and gas-fuelled heating systems. At the same time, rising retail prices and energy efficient behaviour and appliances, eg LED lighting may mitigate some of the demand increase. In addition to changes in demand, government incentives such as the feed-in-tariff will drive high penetration of various forms of generation on LV networks. These combined changes in the requirements of connected customers will introduce significant challenges for network operators.

In order to begin to understand what these changes will mean to networks, network operators will need to measure the existing demand and voltage characteristics of networks at an increasingly granular level, and to develop models which enable them to forecast the effects of future scenarios for the penetration of customers' low-carbon technologies. At present, analogue data such as voltage and current is not routinely captured beyond the primary substation level. However, it is expected that as demands increase, it will be the low voltage networks that will experience both thermal and voltage problems ahead of the higher voltage networks. Given this, it is paramount that network operators quickly begin to fill in the gaps in their understanding of the characteristics of low voltage networks and assets.

The deployment of distributed measurement, sensing and analogue recording instrumentation at points along LV feeders will provide Electricity North West with data that will allow a greater understanding of the operating characteristics and demands of its low voltage distribution networks.

3. SCOPE

This specification covers the technical requirements for:

- The design, manufacture, supply and testing of a data concentrator.
- The design, manufacture, supply and testing of an enclosure to contain the data concentrators.

The equipment offered shall be complete in every respect with all necessary facilities and system functional requirements for reliable continuous operation.

The scope of work shall include the support and maintenance, software tools, and configuration to enable the equipment to perform as required.

The manufacturer shall supply all necessary training and maintenance tools associated with the equipment, together with logic and circuit diagrams to enable diagnosis of faults or loss of functionality that may occur in the future.

Communications with the data concentrator shall be at the discretion of Electricity North West and dependent on geographical and network constraints. The Tenderer shall indicate if the data concentrator is compliant with the various communication and telemetry protocols specified in the body of this document. The Tenderer shall indicate the communication functionality available as an integrated solution within the data concentrator.

4. DEFINITIONS

Approval:	Sanction by the Electricity North West Future Networks Technical Manager that specified criteria have been satisfied.
Contractor:	The person or person's firm or company, including personal representatives, successors and permitted assigns, whose tender has been accepted by Electricity North West.
DNO	Distribution Network Operator
Feature Number	9 character unique identifier for assets shown on the mains records
GPRS	General Packet Radio Service
iHost	iHost is a brand name and provides a low cost integration platform for extension of the main SCADA to include for various remote devices
LED	Light Emitting Diode
RMS	Root Mean Square
SCADA	Substation Control and Data Acquisition
SIM	Subscriber Identity Module
Specification:	The Specifications and schedules (if any) agreed by the parties for the purpose of the Contract.
Sub-Contractor:	Any person (other than the Contractor) named in the Contract for any part of the Works or any person to whom any part of the Contract has been sub-let with the consent in writing of the Engineer, and the legal representatives, successors and assigns of such person.

Supplier:	Any person or person's firm or company who supplies goods to Electricity North West or to its contractor.
Tender:	An offer in writing to execute work or supply goods at a fixed price.
Tenderer:	The person or person's firm or company, including personal representatives, successors and permitted assigns, invited by Electricity North West to submit a tender.

5. GENERAL REQUIREMENTS FOR APPROVALS AND TESTING

5.1 Product not to be Changed

No change in the product, packaging or labelling shall be made after Approval has been granted without prior notice to the Electricity North West Future Networks Technical Manager, and receipt of a written agreement to the proposed change from the Electricity North West Future Networks Technical Manager.

5.2 Electricity North West Technical Approval

The tenderer shall submit, with this tender, proposals for testing which will demonstrate, to the satisfaction of the Electricity North West Future Networks Technical Manager, compliance with this Specification. Such tests shall be carried out without expense to Electricity North West.

Alternatively, the tenderer may submit technical reports and other data that he considers will demonstrate, to the satisfaction of the Electricity North West Future Networks Technical Manager, compliance with this specification. Acceptance of this evidence shall be at the discretion of the Electricity North West Future Networks Technical Manager but will not be unreasonably withheld.

Approval shall be ‘factory specific’ and is not transferable to another factory without the written approval of the Electricity North West Future Networks Technical Manager.

The supplier and product shall comply with all the relevant requirements of Electricity North West documents EPD311 and CP311.

5.3 Quality Assurance

The tenderer shall confirm whether or not approval is held in accordance with a quality assurance scheme accredited under ISO 9000. If not, he shall submit a statement of the quality assurance procedures employed to control the quality of the product, including the performance of suppliers and sub-contractors.

The right is reserved for the Electricity North West Future Networks Technical Manager to require, from time to time, the repeat of such tests as he may deem to be reasonably necessary to demonstrate continued compliance with the specification.

The tenderer shall submit, with his tender, a list of tests and inspections which are carried out on the product prior to despatch which shall demonstrate, to the satisfaction of the Electricity North West Future Networks Technical Manager, fitness for installation and service.

The tenderer shall provide free of charge to Electricity North West such samples as may, in the opinion of the Electricity North West Future Networks Technical Manager, be reasonably required for inspection and/or retention as quality control samples. The Electricity North West Future Networks Technical Manager will confirm the requirement for samples at the time of tendering.

The right is reserved for the Electricity North West Future Networks Technical Manager to make, from time to time, such inspections of the tenderer's facilities as he may deem to be reasonably necessary to ensure compliance with this specification and any contract of which it forms a part.

The tenderer shall submit, with his tender, such details of product packaging disposal, as will enable Electricity North West to comply with the requirements of BS EN ISO 14001: 2004 - Environmental Management Systems.

5.4 Formulation

The tenderer shall submit, with his tender, such details of the formulation and use of the product and associated substances as will enable Electricity North West to comply with the obligations of the Health and Safety at Work Act 1974 and the Control of Substances Hazardous to Health Regulations 2002, in the use, storage and disposal of the product. The tenderer may stipulate, prior to submission of such information, that he requires it to remain confidential and the Electricity North West Future Networks Technical Manager will, if requested, confirm his agreement to this prior to receipt of the information.

5.5 Identification Markings

The tenderer shall submit, with his tender, details of markings which it is proposed to apply to the product or packaging to identify manufacturing batches or items. The forms and content of such markings shall be subject to the approval of the Electricity North West Future Networks Technical Manager, and shall in all cases include the Electricity North West approved description and commodity code number.

The tenderer shall submit, with his tender, such details of marking gross weight on components, assemblies and packages, as will enable Electricity North West to comply with the Health and Safety Manual Handling Operation Regulations 1992, for components, assemblies and packages supplied with a gross weight over 1kg. The forms and content of such markings shall be subject to the approval of the Electricity North West Future Networks Technical Manager.

5.6 Minimum Life Expectancy

The minimum life expectancy of all products covered by this specification is 20 years.

5.7 Product Conformity

Preference will be given to those suppliers who can provide suitable product conformity certification to a recognised or specified standard, or an equivalent certification.

6. REQUIREMENTS FOR TYPE AND ROUTINE TESTING

The Electricity North West Future Networks Technical Manager shall set out the requirement of the following tests to be carried out by the supplier at the supplier's cost.

6.1 Requirement for Type Tests at the Supplier's Premises

These are a series of one-off type tests, which are carried out to ensure the satisfactory performance of the product design, under extremes of operating stresses, and of endurance, as may be appropriate, to be determined by the Electricity North West Future Networks Technical Manager.

These may or may not be destructive tests.

6.2 Requirement for Routine Tests at the Supplier's Premises

These tests may be required to be carried out on every individual unit or component, as specified, or at some regular frequency to be determined by the Electricity North West Future Networks Technical Manager.

The results of these tests may be required to be supplied to Electricity North West with each unit purchased or retained for inspection, at a period to be determined by the Electricity North West Future Networks Technical Manager.

7. CONFORMANCE

The Tenderer shall complete the clause conformance declaration sheets in Appendix A. Failure to complete these declaration sheets may result in an unacceptable bid.

8. TECHNICAL REQUIREMENTS

8.1 General

Monitoring installations shall consist of sensors installed on a LV cable to measure three phase currents and voltages which are fed into a data concentrator housed in an enclosure installed at street level.

The current sensors shall be of the Rogowski coil type or similar and fitted around the core of the underground cable within a breech joint. The voltage shall be provided from a three phase cable termination connected to a standard breech joint on the same cable. All sensors and sensor connections shall be IP65 rated and physically protected throughout their route length. Any voltage sensor leads will be fused, double insulated and protected by a metal sheath when susceptible to public interference (eg in the public highway). The data concentrator shall be fitted in a suitable weather and vandal proof enclosure rated to IP65 where appropriate.

Preference will be given to suppliers providing complete monitoring installation kits. The monitoring kits shall include:

- Suitable current sensors (three phase and neutral)
- Suitable voltage sensors (three phase and neutral)
- A data concentrator complete with suitable communication mode.
- All ancillary installation kit and specialist tools.
- An enclosure to contain the data concentrator and any ancillary kit.

Detailed specifications shall be provided by the Tenderer for all the equipment, including a layout diagram for the enclosure.

8.2 Failures

Tenderers shall provide validated meantime between failure data for the individual modules that make up the installation.

The data concentrator shall be designed to prevent erroneous data from being transmitted due to failure of any hardware component, failure in logic or communication channel errors.

8.3 Maintainability

A design that does not require periodic preventive maintenance and inspection is preferred. If periodic maintenance is required, it shall be possible to perform all such work without taking the equipment out of service.

8.4 Environmental Conditions

8.4.1 Enclosure

A weather-proof enclosure is required to house the monitoring and associated equipment. The enclosure shall not require maintenance for a period of at least 30 years in a polluted or coastal environment according to EN ISO 12944-2 Category C4.

The enclosure shall comply with IEC60529, Protection Class IP65 or better. The cabinet shall be adequately ventilated to prevent damage to any component when exposed to high ambient temperatures.

8.4.2 Data Concentrator

The data concentrator communications equipment and associated supporting equipment shall be suitable for rated operation at elevations up to 1000m above sea level and shall have been type tested for continuous operation over the following environmental conditions:

- Temperature -20°C to +70°C
- Temperature Gradient Up to 30°C/h
- Relative Humidity Up to 95% at 40°C
- Cyclic Damp Heat +40°C to +25°C at 95% Relative Humidity
- Absolute Humidity Up to 29g/m^3
- Vibration (sinusoidal) 2g acceleration 9 to 350Hz
- Shock 15g, 11ms

All of the equipment that forms part of the complete monitoring installation shall be designed and proven to meet the requirements of the following:

- 93/68/EEC: Low Voltage Directive
- BS EN 60068: Environmental Testing
- BS EN 61000-6-2: Generic Immunity Industrial Environment

- BS EN 55022 (Class B): Radio Disturbance Conducted & Radiated (installed in enclosure)

8.5 Immunity from Electromagnetic Interference, Radiated Disturbance and Electrostatic Discharge

The electrical and electronic components of all equipment shall satisfy the appropriate requirements for insulation, isolation, and immunity from electromagnetic interference, radiated disturbance and electrostatic discharge.

The data concentrator, communications equipment and cabinet shall be designed for safe operation in the harsh environment encountered in remote locations with high voltage plant.

Data communication ports shall be demonstrated to withstand disturbance test without permanent corruption of data, and subsequent delay of data transfer.

8.6 Power Supply

All monitoring installation equipment shall operate within the required performance criteria and accuracy and endure without damage, shortening of service life, or undue increase in power supply drain, or excessive heating, power supply voltage variations within the following ranges in accordance with IEC 60870-2-1.

AC-Power supply	415/230 V, 50 Hz
Voltage range	+ 10%, - 15%
Frequency range	± 5%

A battery backup is not required.

8.7 Enclosure Construction

The enclosure shall be suitable for installation in the public highway. The dimensions of the enclosure shall be as small as possible so as to have the minimum impact on the environment around the consumer's premises.

The construction of the cabinet shall be in accordance with the relevant electrical engineering standards detailed in this specification and in accordance with the latest edition of BS 7671, Electricity at Work Act and any current legislative requirements.

All measures shall be taken to prevent the ingress of moisture and the occurrence of corrosion on any part of the monitoring equipment, located within the cabinet.

The cabinet shall be lockable and vandal-proof. Locking arrangements for the cabinets shall be via the use of a hasp and staple to fit Electricity North West standard distribution substation door padlocks as per ES309. The locking point shall be suitably shrouded to prevent access to the hasp. A suitable door stay shall be fitted, with a positive opening feature, to hold the door open at 90°.

Suitable removable lifting eyes shall be provided.

The manufacturer shall fit the Electricity North West property plate and danger of death signs as per Electricity Specification ES356 to the door of the enclosure. Suitable fixing points shall also be provided to allow for the fitting of a site specific nameplate by Electricity North West.

A means of LV power isolation shall be provided to enable maintenance to be safely carried out within the cabinets.

A means to mount an aerial on the outside of the cabinet shall be provided with access to the inside to allow connection of the aerial to the data concentrator.

Any ancillary items or requirement for the cabinets such as heaters, lighting, fixtures and fittings etc. shall be included.

8.8 Data Concentrator

The data concentrator shall be required to provide monitoring, local analysis, data storage and communications/forwarding**.**

8.8.1 Measurements

All measurements shall be capable of being sampled and stored on a 1 minute sampling rate. Sampling and transmission rates shall be remotely adjustable ideally from 1 minute up to 24 hours. Sampling rates are expected to be reduced at individual sites as appropriate dictated by the results obtained.

If the data concentrator has a configurable dead band it shall be possible to configure this remotely.

The following parameters shall be directly measured:

- RMS volt per phase,
- bi-directional RMS amp per phase,
- power factor per phase
- phase angle per phase
- neutral amp,

The following parameters shall be measured or calculated:

- kilowatt hours,
- real power
- reactive power

Average, maximum and minimum values for the voltages and currents shall be provided. For the voltage measurements 10 minute mean RMS values shall be provided to allow comparison against power quality standards.

All measurements shall include identifiers for date, time, site, feature number, data concentrator and phase.

The data concentrator shall have the ability to provide alarms based on pre-programmed parameters. Confirmation shall be provided as to whether the alarm parameters can be changed remotely.

The Tenderer shall provide details of any harmonic voltage and current measurements that can be provided and any additional cost to retrieve these.

If harmonic measurements cannot currently be provided but may be a future upgrade the Tenderer shall provide details of the measurements to be provided, how the upgrade is to be implemented and any additional cost.

8.8.2 Accuracy

Current: ±1% preferred, minimum of better than ±5%.

Voltage: ±1% preferred, minimum of better than ±2%.

8.8.3 Data Storage and Retrieval

The data concentrator shall have GPRS communications as a minimum although alternative communications may be considered for the future evolution of the system. In addition all measurements shall be stored on-site in non-volatile memory (or suitable alternatives) for a minimum of 5 days in case of temporary communications failure or outages. The Tenderer shall detail the available communications options.

Where GPRS communications are included Electricity North West shall issue SIM cards. If this is likely to cause any problems then these shall be identified.

The Tenderer shall state which reporting parameters can be controlled remotely.

The Tenderer shall state which communications protocol can be used.

Electricity North West uses the iHost SCADA data collection platform (as provided by Nortech) and it is preferable that all data from site is direct to Electricity North West's iHost system. The Tenderer shall state if their proposed solution is compatible with iHost and if not, details shall be provided on how compatibility can be achieved.

It is understood that suppliers can offer alternative data hosting solutions. Indication shall be provided on what the specific costs are associated with such systems, the advantage of using such systems and whether the hosted system can integrate with Electricity North West's iHost system. If not, a description shall be provided of what will be required to achieve secure integration and any associated costs.

8.9 Installation

The monitoring installation shall be capable of being installed and commissioned without the need for a customer shutdown.

Due regard shall given to any hard wiring between the voltage termination and the data concentrator regarding the need to provide isolation and fusing. Details shall be provided as to how the data concentrator obtains power to operate and whether additional voltage taps are required.

The clearance between separate cable cores at the point of current monitoring may be as small as 20mm. Sensor options shall be flexible and capable of fitting the space requirements indicated. Photographs of a recent installation shall be provided where appropriate.

The distance between any cable and the cabinet may be considerable; therefore the Tenderer shall provide details of the available lengths of the current and voltage sensor cables.

The current sensors contained in a cable joint will be encased in resin. The Tenderer shall provide confirmation that the current sensors will not be affected by this.

The Tenderer shall provide details of any additional items that will need to be procured by Electricity North West in order to fully install the monitoring equipment.

8.10 Deployment History

LV monitoring is a relatively recent activity for UK DNOs. The Tenderer shall provide information on similar installations undertaken for UK DNOs. Information shall also be provided on which aspects (if any) of the proposed solution have not had any UK DNO field trials.

9. DOCUMENTATION, TRAINING, AND SUPPORT

The supplier shall be available to support the installation of the monitoring equipment and where appropriate the commissioning of the data interfaces into Electricity North West's iHost platform. This shall include on-site support for the first two installations.

The supplier shall provide any necessary training of installation and operating personnel.

A copy of the installation and configuration manual for the system shall be provided.

The supplier shall provide details of any diagnostics or maintenance requirements. If this can be carried remotely, details shall be provided so that Electricity North West can investigate the implementation into existing systems.

10. DOCUMENTS REFERENCED

Health and Safety at Work Etc Act 1974

Electricity at Work Regulations 1989

Control of Substances Hazardous to Health Regulations 2002

Manual Handling Operations Regulation 1992

93/68/EEC	Low Voltage Directive
BS EN 55022	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
BS EN 60068	Environmental Testing
BS EN 60439	Low-voltage Switchgear and Controlgear Assemblies
BS EN 60529	Degrees of Protection provided by Enclosures (IP Code)
BS EN 60870	Telecontrol Equipment and Systems
BS EN 61000	Electromagnetic Compatibility (EMC)
BS EN ISO 9000	Quality Management Systems
BS EN ISO 14001	Environmental Management Systems
BS 7671	IET Wiring Regulations
EPD311	Approval of Equipment
CP311	Equipment Approval Process

ES309	Substation Locking
ES356	Notices and Nameplates

12. KEYWORDS

Data; LV; Monitoring.

APPENDIX A

SELF CERTIFICATION CONFORMANCE DECLARATION

SECTION BY SECTION CONFORMANCE WITH SPECIFICATION

The manufacturer shall declare conformance or otherwise, section by section, using the following levels of conformance declaration codes.

Conformance Declaration Codes

N/A = Section is not applicable/appropriate to the product/service

C1 = The product/service conforms fully with the requirements of this section

C2 = The product/service conforms partially with the requirements of this section

C3 = The product/service does not conform to the requirements of this section

C4 = The product/service does not currently conform to the requirements of this section, but the manufacturer proposes to modify and test the product in order to conform.

Manufacturer:

Product/Service Description:

Product/Service Reference:

Assessor

Name: **Company:** **Signature:** **Date:**

Section	Section Topic	Conformance Code	Remarks (Must be completed if Conformance Code is not C1)
3	Scope		
5.1	Product not to be Changed		
5.2	Electricity North West Technical Approval		
5.3	Quality Assurance		
5.4	Formulation		
5.5	Identification Markings		
5.6	Minimum Life Expectancy		
5.7	Product Conformity		
6.1	Requirements for Type Tests at the Supplier's Premises		
6.2	Requirement for Routine Tests at the Supplier's Premises		
7	Conformance		
8.1	General		
8.2	Failures		
8.3	Maintainability		
8.4.1	Environmental - Enclosure		
8.4.2	Environmental – Data Concentrator		

Section	Requirement	Conformance Code	Remarks (Must be completed if Conformance Code is not C1)
8.5	Immunity from Electromagnetic Interference, Radiated Disturbance and Electrostatic Discharge		
8.6	Power Supply		
8.7	Enclosure Construction		
8.8	Data Concentrator		
8.8.1	Measurements		
8.8.2	Accuracy		
8.8.3	Data Storage and Retrieval		
8.9	Installation		
8.10	Deployment History		
10	Documentation, Training and Support		

Additional Notes: