Monitoring Equipment Specifications ENWL - Low Voltage Network Solutions (Draft)

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1. Overview

An initial and critical part of the Low Voltage Network Solutions project is the deployment of monitoring devices for approximately 1000 representative LV feeders. This requires strategic decisions in terms of the specifications of the corresponding devices, including the parameters to be monitored, the corresponding 'architecture' for data acquisition and management, and the ideal locations in the feeders. This draft outlines basic requirements that will be adapted according to the technical and economic aspects of the project.

2. Basic Specifications for the Monitoring Devices

Parameters. The monitoring devices will be deployed in three-phase 400V circuits. Although the different schemes for the monitoring locations in a given feeder will be discussed in the next section, it is important to highlight that –when possible– all the three phases and the neutral will require the following parameters to be monitored:

- Single-phase RMS voltages (volts)
- RMS currents (amperes)
- Real and reactive power (kW, kVar)

It is desirable to also monitor the harmonic levels of the selected feeders. However, this will only be necessary for those monitors located at the secondary side of the distribution transformer. Alternatively, if more cost-effective, harmonic measurements could be taken only one or a few times per year per distribution transformer or feeder.

Sample rate. Data should be recorded at least every minute. Faster sample rates could be explored but it is believed a one-minute granularity is adequate enough to capture the steady-state behaviour of (conventional and non-conventional) loads, as well as distributed generation (e.g., photovoltaic panels).

Data Management & Communications. Given the proposed sample rate, large volumes of data will be produced. This, combined with the sheer size of the envisaged deployment, is likely to make the manual retrieval of data a significant burden (in terms of man hours) for ENWL. Consequently, it is suggested that the monitoring devices feature communication capabilities to securely stream data to a server from which it can be downloaded. It is important to note that given the lack of physical (i.e., wired) communication means, GPRS or 3G would be the most appropriate technologies. In addition, data should be time-stamped to allow 'synchronisation' of the different monitors in a given feeder or group of feeders.

Loss of mains. Once power is restored following an outage, monitoring devices should be capable of 'reboot' their systems automatically in a way that previous configurations are kept.

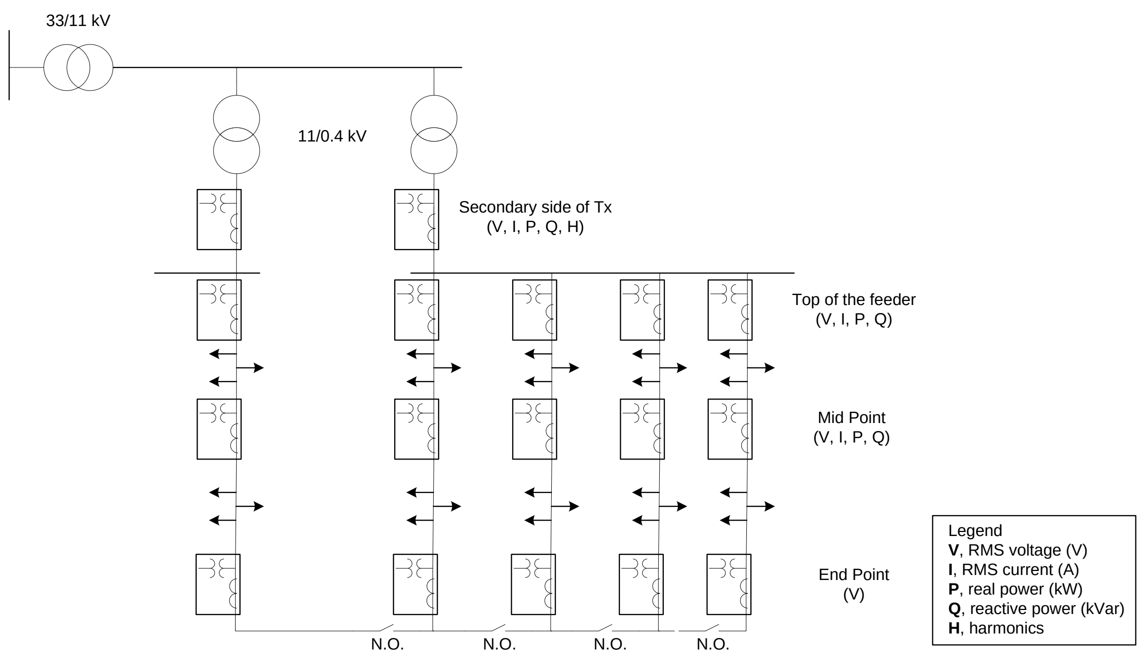
3. Ideal Locations for Monitoring Devices

This section describes the different ideal locations for the deployment of monitoring devices (once the representative feeders have been chosen).

The figure below presents a monitored 4-feeder LV network (right hand side) that features measurements taken from the secondary side of the transformer as well as from the top (three-phase), middle (single-phase; e.g., lamp post), and end (three-phase; e.g., at the normally open switch) of each of the feeders. At least three monitoring points are required per feeder in order to have an observability level useful for model validation.

It is highly desirable to explore the option of having more points (e.g., lamp post installations), and if possible, having a few feeders with all (or most) customers being also monitored.

In addition, the figure below also shows another monitored feeder from another LV network (left hand side) that is interconnected through a normally open point. This particular scheme will allow exploring the benefits or challenges from interconnected (meshed) LV networks. Note that if feeders are not going to be interconnected, then only voltage measurements are required at the end points.



Monitored 4-feeder LV network

4. Manufacturers

Three manufactures/distributors where approached initially. All the technologies are, in general, capable of delivering the basic specifications presented previously. Some brief comments are given below.

National Instruments (UK)

The compact RIO system is a very flexible, modular platform for monitoring and control purposes (specifications in "Appendix NI"). Sample rates, data formats, control processes, etc. can all be tailored through a NI-based programmable interface (LabView). It has wireless capabilities for data retrieval and code reconfiguration.

One of the key advantages of the product is its flexibility. It allows fast code reconfiguration which makes it possible to explore the benefits of, for instance, different sample rates. However, the extensive deployment required for the project makes this technology unfit for the following reasons: 1) each unit would require being assembled and coded; 2) hard cases will need to be produced for 'street level' monitoring; and, 3) data transfer to servers might require third party services. Consequently, this technology would only be advisable for a small monitoring area (e.g., a few LV feeders).

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I M H Technologies Ltd (UK)

IMH Technologies are distributors of Power Standards Labs (PSL) products. Particularly, the PQube monitor (specifications in "Appendix IMH"), features a number of capabilities that make it suitable for the project. This platform is also modular, but is in many ways an 'off the shelf' product as it comes already configured for monitoring and data management purposes. In addition, a rugged case (for 'street level' monitoring) is also available. It is also a flexible platform in the sense that, apart from being modular, allows tailoring the code for the creation of reports (and data management). One disadvantage is the data transfer to servers: although the platform is capable of using 3G (or GPRS) modules, this is carried out through another party.

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EFACEC Engenharia e Sistemas, S.A. (Portugal)

This company has already being involved in Smart Grid-related deployments (see "Appendix EFACEC InovGrid"). Their product range includes the GSmart and the MBox (specifications in "Appendix EFACEC 1" and "Appendix EFACEC 2"). The former basically works as a hub placed at the distribution transformer where local parameters are monitored. Data from monitors (MBox) placed at different points of the feeders are also gathered by the GSmart. The hub then transfers all the necessary data to the corresponding server. Both devices come in cases suitable for the project. The main advantage here is that this is a proven architecture that will need to be tailored mainly to the specifications of the communication technology to be adopted by the project.

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