Future Networks Newsletter Winter 2017/18

WESTERN POWER DISTRIBUTION INNOVATION

New Projects

2018 Call for NIA Projects.

Building on the success of our previous Network Innovation Competition (NIC) third party calls we are now welcoming third party projects to be funded through the Network Innovation Allowance (NIA).

In order for a project to qualify for NIA funding it must be suitably innovative that WPD or another DNO would not perform it in its normal course of business due to the commercial, technical, operational or regulatory risks associated with the activity.

We have recently published the first Distribution System Operability Framework (DSOF), an assessment of technical issues facing Distribution Network Operators (DNOs) as they become Distribution System Operators (DSOs). We are actively looking for future technical and commercial issues which could impair our ability to operate and maintain our networks efficiently whilst developing capacity for new connections. The DSOF highlights three core areas which we have previously identified in our business plan, Assets, Network operations and Customers and are now looking for a range of projects from feasibility studies, first of a kind trials through to system approach solutions ranging from £100k to £2.5M.

The call for projects can be found through Achilles, ENA's Collaboration Portal and on our Innovation website **here.**

The Deduce project (Determining Electricity Usage with Consumer Electronics) was registered in October 2017. The aim of this project is to investigate the potential for very low cost distribution substation monitoring (sub £100) through the use of indirect measurement and consumer electronics.

By measuring parameters such as temperature, vibration or noise, loading could be inferred without the need for more costly sensors. Indirect measurement will also allow for the use of existing, potentially cheaper, sensor packages.

(right: example of a typical distribution substation)

The monitoring devices should be capable of providing general loading profiles of substations and allow the roll out of full monitoring to be more targeted. By reducing the requirements for full monitoring, low cost monitoring can provide a financial benefit to DNOs and the wider customer. The project will have two main strands of research:

- Investigation and testing of potential sensors and packaging by Loughborough University. This will focus on low cost sensors and existing measurement devices (such as smart phones); and
- A UK wide university competition supported by Loughborough University aimed at exploring non-traditional solutions. This includes prizes of up to £5000 for successful candidates.

The successful sensors will be built and tested in a laboratory at Loughborough University with possible testing on University owner LV facilities where appropriate.

The project is expected to run over 10 months; learning will then be shared with other network licensees. To date initial investigations into the various options have been conducted with the targets for testing identified. In addition the student competition has been advertised, the closing date for first proposals is the 16th February.

Assets

Our EV Emissions project is reaching its conclusion, the full report is being finalised at present and will be available on our website towards the end of February.

In order to address the various challenges presented by the predicted large-scale and rapid installation of private and public Electric Vehicle (EV) charging points over the next few years, the scope of this project was to investigate the impact of EV on the public distribution network. The scope of works included the following aspects:

- Specification and installation of power quality measurement equipment
- Determination of background harmonic distortion
- Data acquisition during EV charging
- Harmonic data processing and anonymising
- Harmonic data analysis & modelling
- Presentation of findings

For this assignment 23 different vehicles were tested, with charge rates from 2.3kW to 7.2kW (10A to 32A). Each vehicle had data taken for five different charge cycles with initial charge states ranging from 0 to 90%. Measurements were made of the 1st to 50th harmonic current for each charge cycle (10 minute averaged), and the 1st to 50th harmonic current measured for each phase, combining some charge cycles (1 second averaged).

The harmonic current distortion from each vehicle were tested against the IEC 61000-3-2 and -12 limits The IEC 61000-3-2 limits only apply to equipment with a load current of less than 16 A per phase and therefore some of the vehicles are not expected to be compliant with this standard. However, compliance with this standard would allow the connection of EV from a power quality persepective to be unconditional and therefore is a good starting point to determine acceptability.

Taking the typical harmonic current profiles for an EV vehicle detailed above the maximum number of EVs that can connect to a single point of connection was determined. However, an LV feeder could have vehicles connected at different locations and in clusters all of which would impact on the source impedance experienced by the harmonic currents. Therefore the maximum number of EVs that can be connected along a feeder is a range rather than a fixed value depending on their distribution and clustering. The LV feeder was assessed to determine if it was within the standards by which DNOs assess the impact of harmonics on their networks (G5/4).

Operations

The Statistical Ratings for Distribution Overhead Lines project began in July 2015 and is due to complete in June 2018. The principal aim of the project is to re-assess and update the methodology and underlying data used to derive overhead line ratings.

Overhead line ratings in the UK are probabilistic – they are expressed as having a certain “exceedance”, or risk, of the full rated load causing a conductor’s temperature to rise above its design temperature. The risk levels chosen are low, and selected in order to limit both the duration and magnitude of any temperature rise. Probabilistic ratings are calculated by applying a scaling factor to a reference rating – a rating calculated from a reference set of weather conditions by applying standard heat balance equations.

A function linking the scaling factor to a desired risk level was experimentally derived by the CEGB (predecessor of National Grid), in the late 1970s and early 1980s. The original experiment utilised just one circuit and one conductor size typical of the transmission system, rather than one representative of the distribution system. It’s been identified in more recent work that the seasonal boundaries chosen no longer reflect what is seen today.

A key part of this project, completed in January 2018, has been to re-create the original experiment but to do so in a way that made it more representative of the distribution environment. A test rig was constructed at WPD’s Stoke depot, consisting of four separate circuits, strung with a total of three different sizes of conductor and energised continuously for two years. During operation, ambient conditions (temperature, wind speed, wind direction, solar radiation) and conductor temperatures were all monitored continuously. In all, this has allowed data to be gathered for seven different combinations of conductor size and applied current.

Data collection was completed in January 2018, and data analysis has now begun. Early indications are that the data quality is very good, although the test rig suffered a catastrophic failure over the summer months of 2016. Despite this, enough data was collected in order to progress with detailed analysis. Initial analysis and derivation of a new scaling function has already revealed a more accurate seasonal pattern.

Customers

The Losses Investigation project aims to estimate technical losses on the LV and HV network, and the output is intended to allow WPD to economically target loss mitigation work for the benefit of customers. The project started in 2015 and is due to complete in 2018.

The project's outline delivery approach is:

- Install monitoring on sample HV and LV feeders;
- Use gathered data to design and validate loss estimation methods; and
- Produce loss estimates for a range of unmonitored HV and LV feeders.

The project is being undertaken in collaboration with Manx Utilities Authority and Loughborough University, with the LV monitored feeders located in the Isle of Man.

A key premise for the project has been to utilise reasonably available monitoring devices, providing one minute sample periods, for up to nine variables per phase (including voltage, current, power etc.). The monitoring devices are also time synchronised.

For LV feeders we have utilised Lucy Gridkey monitors for LV substation measurements, and EDMI meters at customer premises. In total 335 meters and 15 substation/overhead feeder monitors have been installed.

For HV feeders we have developed a device variant on the established Lucy Gridkey LV substation measurement devices for monitoring at Primary Substations and HV customer connections. In total, 181 monitors have been installed on 11 HV feeders (including overhead installations).

Loss assessments, using measurement data, are now being produced on a monthly basis for the 11 HV feeders, and the 11 LV feeders.

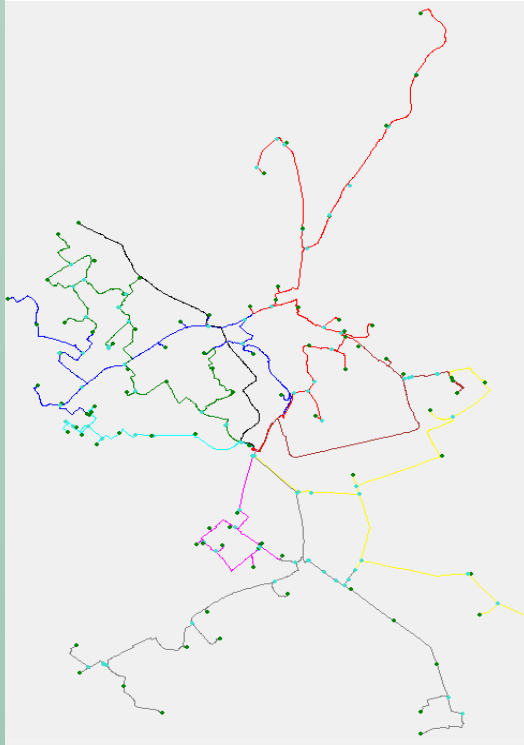
Methods of estimating losses using readily available data have been investigated, and a preferred approach identified for HV feeders. This approach models the network based on existing network data, using a project-specific load model for 17,520 half-hour periods in a year. Tests of the method on the monitored HV feeders show that it produces estimates that closely match the measurement-based assessments. This compliments ongoing work to design loss estimation methods for LV feeders.

Work on designing loss estimation methods for LV feeders is also underway.

Progress with the project has recently been presented at WPD's Losses Strategy Consultation Event in Birmingham, and at the energy networks industry's annual innovation conference.

Lucy Gridkey LV/HV monitoring devices for substations

EDMI 3-phase meter used at customer premises



Geographical layout of Primary Substation HV feeders.

Find out more

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