WPD INNOVATION

Transforming the electricity network

Primary Networks Power Quality Analysis

NIA Major Project Progress Report

October 2020 – March 2021

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Disclaimer

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1. Executive Summary

Primary Networks Power Quality Analysis (PNPQA) is funded through Ofgem's Network Innovation Allowance (NIA) and has a budget of £1,358,400 of which £1,222,560 has come from the Network Innovation Allowance (NIA) funding. PNPQA was registered in March 2018 and will be completed in June 2021.

PNPQA aims to reduce uncertainties around the power quality (PQ) impact across the Primary Network and therefore facilitate increased integration of low carbon technologies (LCTs). This will be achieved through implementing a monitoring and analysis system for assessing the PQ of waveforms in Primary Networks, verifying the accuracy of the Primary Network equipment used for PQ monitoring, and using modelling to predict the future PQ impacts of increased integration of LCTs.

This report details progress of the project, focusing on the last six months, October 2020 – March 2021.

1.1. Business Case

Over recent years there has been a sharp increase in the amount of LCTs connected to the electricity network as part of the transition to a low carbon economy. Significantly more LCTs will need to connect in order for the UK to reach its decarbonisation goals.

LCTs are often connected to the network using power electronic interfaces that have different characteristics to the types of generators and demands that connected in the past. The impact of LCTs on power quality (such as harmonics, flicker, voltage sags and swells, and voltage unbalance) within primary networks is uncertain, particularly the future impacts of increased LCT integration.

Connections of LCT generators are set to continue at a pace; for instance, since PNPQA was registered National Grid revised up their estimate of LCT generation capacity by 2030 from 83 GW to 117 GW, which is nearly double the present capacity. Additionally, the UK Government's Clean Growth Strategy targets electrification of transport and heating, which indicates there will be a significant increase in LCT demand connections.

In order to facilitate LCT connections, we are required to publish PQ information; however, current business practices would make this labour and cost intensive to achieve fully. At present PQ monitoring is limited in both space and time, typically with a single site being monitored in an area for a week per year or less. As a result, worst-case operating conditions may not be captured and there is little visibility of PQ away from LCT points of connection. Use of the stand-alone monitoring model is also labour intensive and difficult to scale. This is because, data retrieval from these monitors requires site visits and subsequent analysis of PQ data is not automated..

An additional drawback of the stand-alone monitoring approach is the uncertainty whether this strategy proves an accurate picture of PQ within the networks. PNPQA aims to overcome these shortcomings and provide widespread visibility of PQ within Primary Networks in a much more labour and cost-efficient way than simply scaling up the present approach.

1.2. Project Progress

This is the sixth progress report. It covers progress from the start of October 2020 to the end of March 2021.

Nortech Management Ltd. is contracted as a Project Partner, responsible for day-to-day project management and delivery of the project, which is split in to four phases:

1. Design – this first phase included testing the harmonic performance of voltage transformers (VTs), selection of trial areas and sites, specifying PQ monitor interfaces, PQ analysis software and PQ monitor connection design;
2. Build – this is the most recent phase, which included developing interfaces to enable remote communications from PQ monitors, purchasing and installing PQ monitors and developing software to automate the retrieval and analysis of PQ monitor data;
3. Trial – this is the current phase of the project and combines a wide scale trial of enhanced power quality monitors and collection platform. The enhanced monitors have capability to send data back to a central location whilst the analysis platform has capability to automate the collection and analysis of PQ data, along with modelling to understand the future impact of increased LCTs on Primary Networks; and
4. Report – this is the final phase of the project, and includes dissemination events, drafting policies for Business-as-Usual adoption, and producing the close down report.

During the previous reporting period (April 2020 to September 2020), final features of the PQ analysis automation software were completed, tools were developed to assist with analysis of the PQ monitoring data gathered during the project's communication PQ monitor trial, network models for future-looking PQ studies were enhanced and the National Physical Laboratory (NPL) started follow-up testing of the harmonic performance of Voltage Transformers (VTs).

During the present reporting period, the communicating PQ monitor trial was completed. The data gathered over the year of the trial has been analysed using the analysis platform and a PQ data analysis report has been produced.

The network models developed during the previous reporting period have been used for future-looking power system studies to understand the potential future impacts of LCTs. The studies have been completed and a results report has been produced.

The follow-up VT harmonic testing at NPL has progressed although this activity will continue for a couple of months past the project's original end date as the testing was delayed due to COVID-19 response measures.

Several project dissemination events and technical papers have been produced.

1.3. Project Delivery Structure

1.3.1. Project Review Group

The PNPQA Project Review Group meets on a bi-annual basis. The role of the Project Review Group is to:

- Ensure the project is aligned with organisational strategy;
- Ensure the project makes good use of assets;
- Assist with resolving strategic level issues and risks;
- Approve or reject changes to the project with a high impact on timelines and budget;
- Assess project progress and report on project to senior management and higher authorities;
- Provide advice and guidance on business issues facing the project;
- Use influence and authority to assist the project in achieving its outcomes;
- Review and approve final project deliverables; and
- Perform reviews at agreed stage boundaries.

1.3.2. Project Resource

WPD: Steven Pinkerton-Clark (Project Manager for WPD)

Nortech Management Ltd: Project Partner, responsible for day-to-day project management and delivery of the project:

- Samuel Jupe (Project Executive for Nortech)
- James King (Project Manager for Nortech)
- Sid Hoda (Software Development Manager for Nortech)
- Simon Hodgson (Technical Manager for Nortech)

1.4. Procurement

The following table details the current status of procurement for this project. Only one item remains active with some delivery remaining, and this has been highlighted in bold.

Table 1-1: Procurement Details

Provider	Services/Goods	Area of project applicable to	Anticipated Delivery Dates
Nortech Management Ltd	Day-to-day project management, PQ monitor interface hardware, software development	All	March 2018 – March 2021
The University of Manchester	VT harmonic performance testing	VT testing	Delivered June 2018 – December 2019
National Physical Laboratory	Further VT harmonic performance testing	VT testing	Active April 2020 – May 2021
(undisclosed)	33 kV 1-phase VT	VT testing	Delivered October 2018
(undisclosed)	33 kV 1-phase VT	VT testing	Delivered October 2018

7com Ltd	Demo PQ monitor	PQ monitor trials	Delivered July 2018
IMH Technologies Ltd	Demo PQ monitor	PQ monitor trials	Delivered July 2018
Siemens plc	Demo PQ monitor	PQ monitor trials	Delivered October 2018
7com Ltd	PQ monitors for trials (a-eberle PQI-DA smart)	PQ monitor trials	Delivered February 2019
IMH Technologies Ltd	PQ monitors for trials (PSL PQube3)	PQ monitor trials	Delivered February 2019 & Sept/Oct 2019
Siemens plc	PQ monitors for trials (Siemens SICAM Q200)	PQ monitor trials	Delivered February 2019
Accutest Ltd	Current clamps for PQ monitors	PQ monitor trials	Delivered September 2019

1.5. Project Risks

A proactive role in ensuring effective risk management for PNPQA is taken. This ensures that processes have been put in place to review whether risks still exist, whether new risks have arisen, whether the likelihood and impact of risks have changed, reporting of significant changes that will affect risk priorities and deliver assurance of the effectiveness of control.

Contained within Section 7.1**Error! Reference source not found.** of this report are the current top risks associated with successfully delivering PNPQA as captured in our Risk Register. Section 7.2 provides an update on the most prominent risks identified at the project bid phase.

1.6. Project Learning and Dissemination

Project lessons learned and what worked well are captured throughout the project lifecycle. These are captured through a series of on-going reviews with stakeholders and project team members, and will be shared in lessons learned workshops at the end of the project. These are reported in Section 5**Error! Reference source not found.** of this report.

Project-specific dissemination through webinars have been provided, and details can be found in 2.6.

2. Project Manager's Report

2.1. Project Background

PNPQA is split in to four phases:

1. Design – this first phase of the project included testing the harmonic performance of VTs, selection of trial areas and sites, specifying PQ monitor interfaces and PQ analysis software;
2. Build – this second phase included developing interfaces to enable remote communications from PQ monitors, purchasing and installing PQ monitors, developing software to automate the retrieval and analysis of PQ monitor data, and building power system and LCT models for future-looking PQ studies;
3. Trial – this third phase combined a wide scale trial of communicating power quality monitors with software to automate the collection and analysis of PQ data, along with modelling and analysis to understand the future impact of increased LCTs on Primary Networks; additionally, this phase also includes follow-up VT harmonic testing; and
4. Report – this is the current and final phase of the project, and includes production of final reports, creation of policies for business-as-usual adoption, and producing the close down report.

2.2. Project Progress

The project is currently in the final phase (Report), with a single activity from the third phase (Trial) carrying on through this reporting period. The following progress has been made:

- Automated retrieval of power quality data has continued to be received from the power quality monitors installed during previous reporting periods;
- Trials of automated PQ analysis software has been completed;
- Analysis of the PQ monitoring data gathered during the trial is complete and a PQ data analysis report has been produced;
- The power system models for future-looking power system studies of the potential PQ impacts of increased LCTs have been completed and a results report has been produced;
- Follow-up VT testing at NPL has continued, including testing of VT frequency response, linearity, and effect of different burdens.

More detail of the progress within each of these activity areas for phase 1 is provided in the subsections within section 2.3 below, for phase 2 within section 2.4, for phase 3 within section 2.5, and for phase 4 within section 2.6. Next steps for within the next reporting period are described in section 2.7.

2.3. Phase 1: Design

All activities in Phase 1 were completed in previous reporting periods.

2.4. Phase 2: Build

All activities in Phase 2 were completed in previous reporting periods.

2.5. Phase 3: Trial

The Trial phase includes several activities that utilise the systems developed and deployed during the Build phase, including analysis of PQ data from the PQ monitor trial, trials of the PQ analysis automation software, power system studies and follow-up VT testing.

2.5.1. PQ Monitor Trial Data Analysis

This activity is concerned with analysing the PQ data collected by the monitors installed during the Build phase of the project.

Progress within this reporting period

The focus of this activity over the present reporting period has been completing the analysis of the PQ monitoring trial data and producing the project's data analysis report.

The PQ data analysis has examined the present PQ impact of LCTs, variation of PQ between locations and over time and the performance of the PQ monitors that were part of the trial.

Aggregates of harmonic voltage measurements from over a year of data for the different sites has been examined for the two main trial areas. An example of measurements from across Meaford C network group is shown in Figure 2-1 . Examples from the from Ryeford substation GT1A) network group is shown in in Figure 2-2 with GT1B side of this group shown in Figure 2-3.

For the Meaford and Ryeford C areas, the 5th and 7th harmonic orders ubiquitously high across the group, but in the high LCT area (Ryeford, GT1B side) other harmonic orders have high magnitudes at some sites, such as the 15th, and several higher order harmonics (the 45th and 49th for example).

These plots also show how comparison of the harmonic profile across the group, allows better judgement to be made as to how much capacity is left than in comparison to having to rely upon the measurement taking at the 33 kV source. For example, using the source measurement at Meaford as a proxy for the available capacity, would overestimate the available headroom for new connections in certain locations within that group.

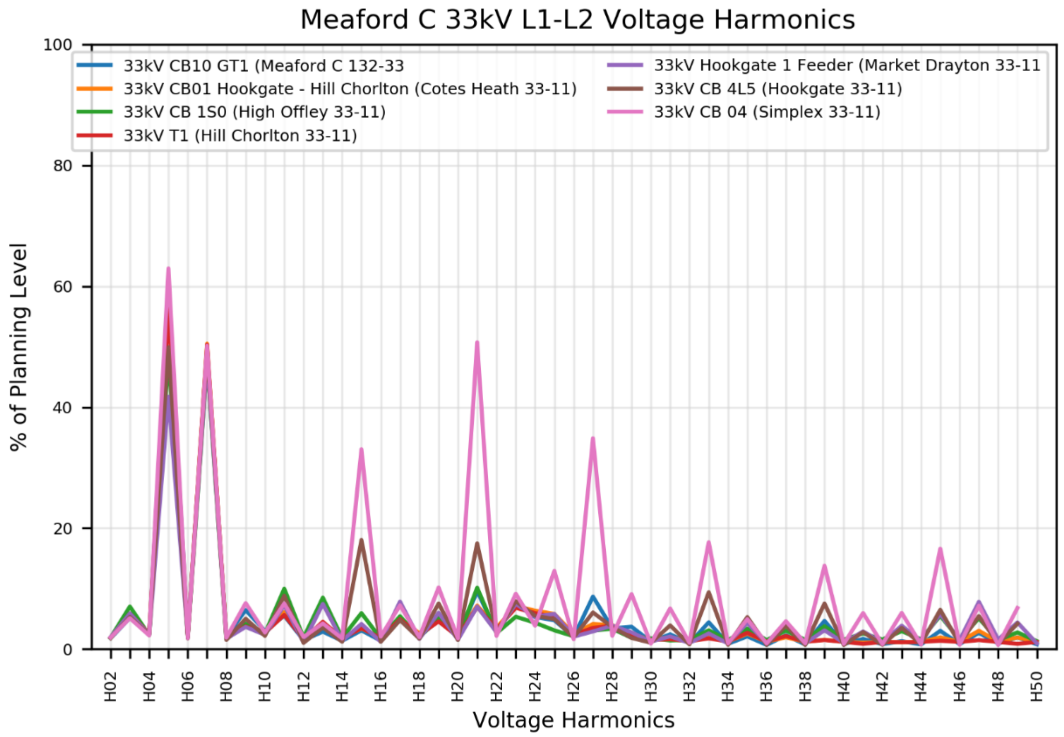

Figure 2-1: 95th percentile aggregate voltage harmonic values for the Meaford C 33 kV sites calculated using all available data

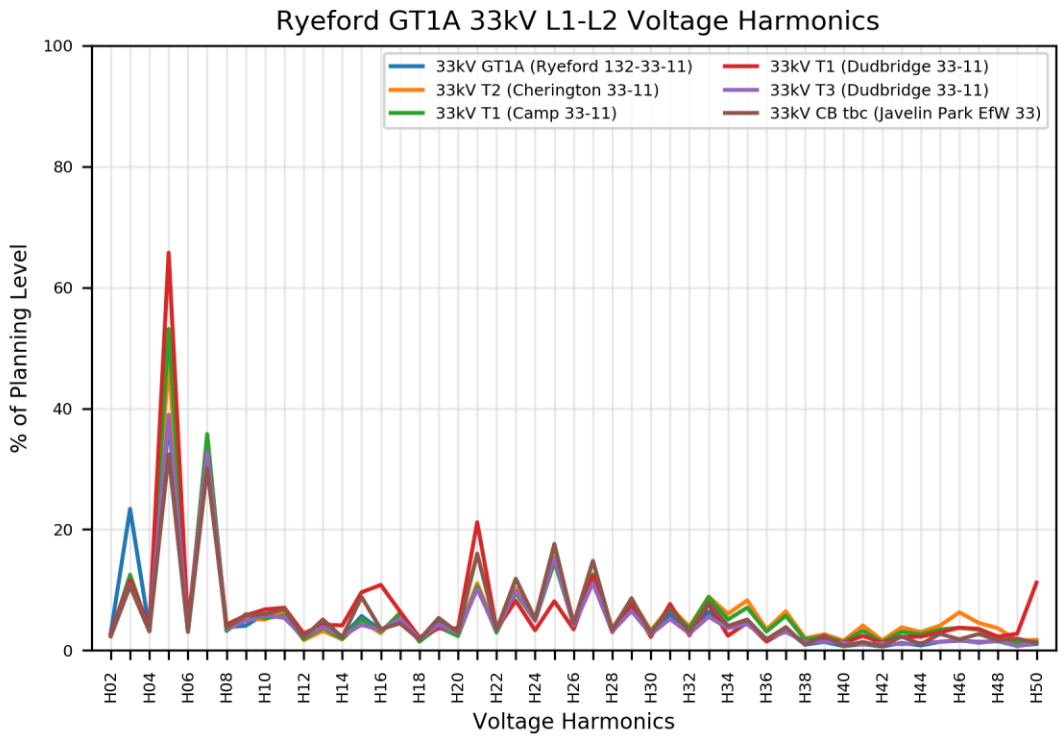

Figure 2-2: 95th percentile aggregate voltage harmonic values for the Ryeford (GT1A) 33 kV sites calculated using all available data

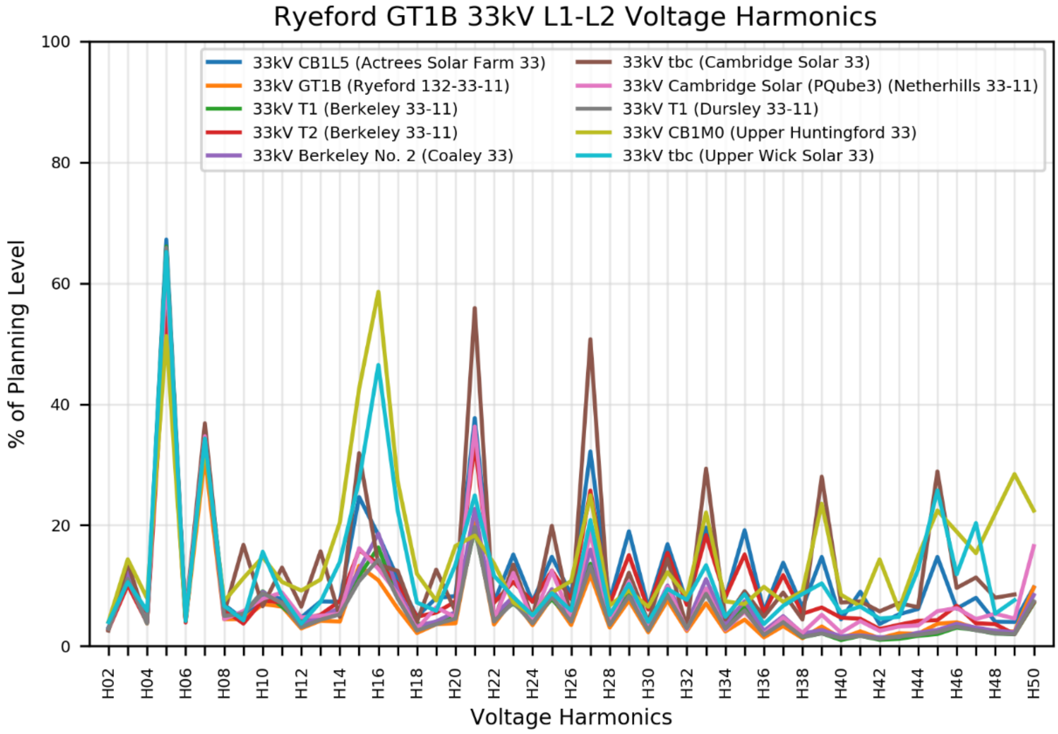

Figure 2-3: 95th percentile aggregate voltage harmonic values for the Ryeford (GT1B) 33 kV sites calculated using all available data

Analysis of the harmonic voltages and currents at LCT sites has revealed that harmonic currents are dependent on the power output of the LCTs, but the relationship between the two is often not straightforward. This can be seen in Figure 2-4 and Figure 2-5. Figure 2-4 shows the power output and 16th harmonic voltage at a solar PV farm over three days. It is clear to see the 16th harmonic voltage is only present when the solar farm is producing output, and the harmonic voltage is roughly proportional to the power output level. However, at the highest power output, the harmonic voltage is actually less than at lower output levels. This is illustrated more clearly in Figure 2-5, which is a scatter plot of the fundamental current (which is proportional to the power output) versus the 16th harmonic current (at this site the harmonic current and voltage have a linear relationship). As Figure 2-5 shows, the harmonic current is dependent on the fundamental current, but it is not a proportional relationship, with the peak at about 60% of the maximum power output and then the harmonic current reduces whilst the power carries on increasing. The learning point from this is that the harmonic emissions from power electronic devices should not be considered to vary proportionally with the fundamental and are instead non-linear and to some extent stochastic in nature.

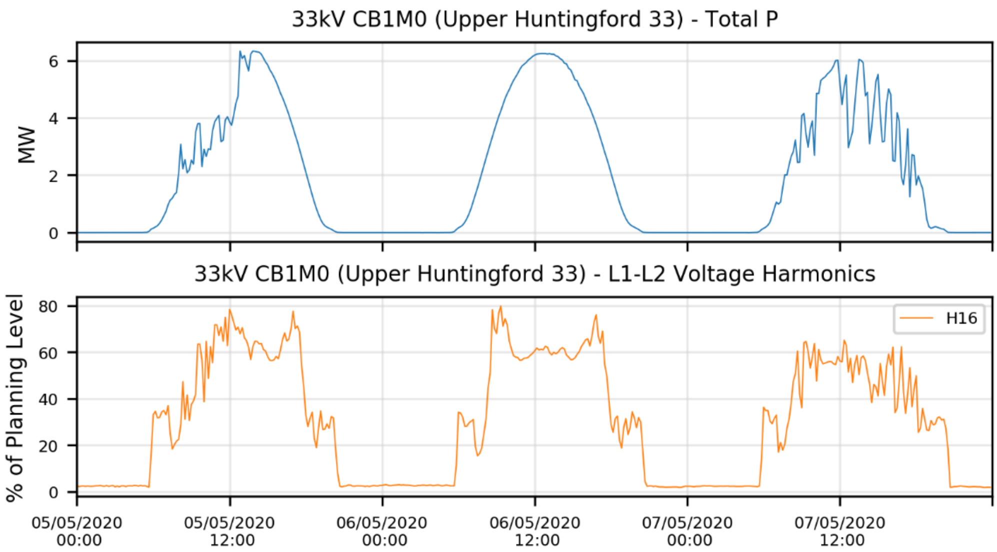

Figure 2-4: Power output and the 16th harmonic voltage at Upper Huntingford solar over 3 sunny days

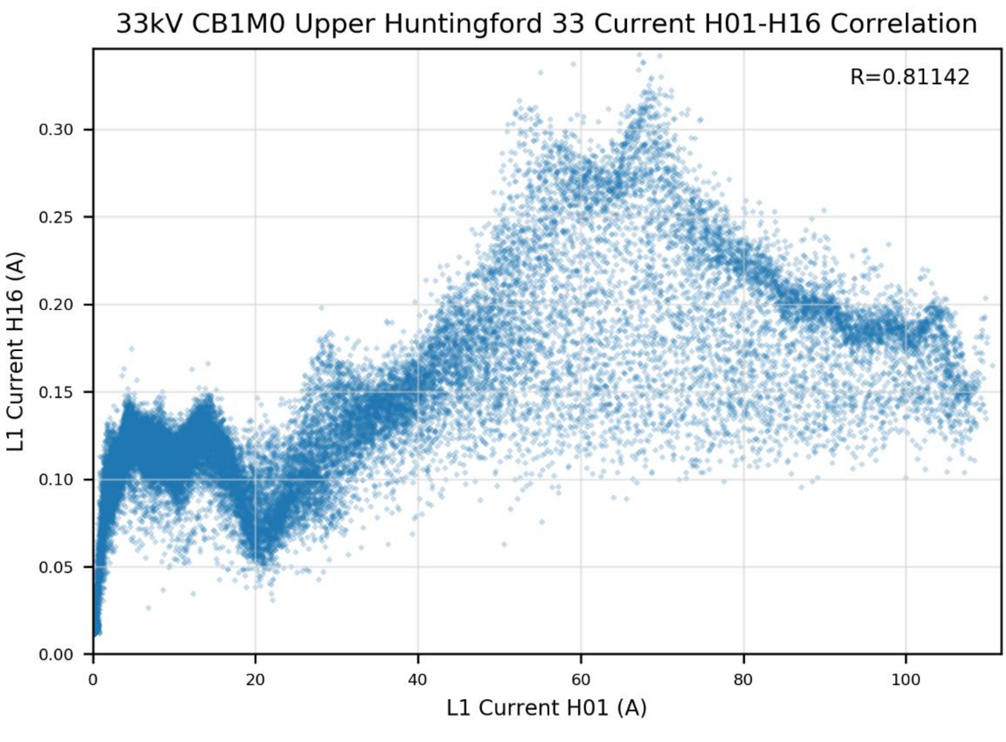

Figure 2-5: Scatter plot of fundamental current vs. 16th harmonic current for Upper Huntingford solar farm using approximately a year of data gathered at 10 minute intervals

Other analysis of the harmonic voltage and current phasors has revealed evidence at some sites of harmonic voltages being reduced as a result of harmonic current flow of LCTs.

Analysis of the monitoring data has shown that PQ measurements can vary substantially from site to site even within the same network area, and they can also vary substantially over time at individual sites. This has highlighted the importance of continuous monitoring of PQ at more than one site in an area in order to gain sufficient PQ visibility to capture representative conditions, Figure 2-6 is an example of this effect.

The figure is a box plot showing the distribution of weekly 95th percentile (aggregate) values for the 16th voltage harmonic for each 33 kV site in the Ryeford GT1B network area. The outermost vertical dashes of each plot indicates the minimum and maximum weekly aggregate values. It is clear to see that the uppermost two sites (Upper Wick and Upper Huntingford) experience a large variation in the weekly aggregates (over 40% variation with respect to the planning level), particularly Upper Huntingford, meaning that it less likely that a single week of data would be representative of other weeks. Furthermore, it can be seen that the range of values for those top two sites does not overlap with the ranges for some of the other sites, such as the BSP; the implication of this is that data gathered from one site may not be representative of the conditions seen at another site. As an example, if the measurements taken at Ryeford were used to study a new connection at Upper Huntingford, then users would assume that there was more capacity available than was really available.

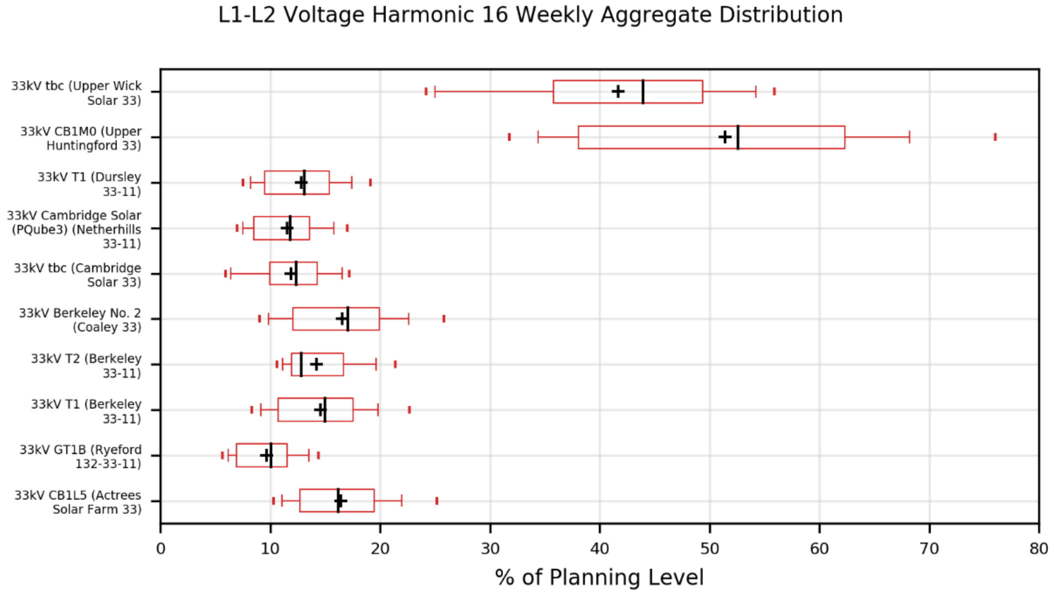

Figure 2-6: Box plot showing the distribution of 16th harmonic voltage weekly aggregates for the Ryeford (GT1B) 33 kV sites

This activity is now complete.

2.5.2. PQ Analysis Automation Software

During the Trial phase of the project, this activity involves our staff trialling the PQ analysis automation software features that were developed during the Build phase.

Progress within this reporting period

The software features developed during the previous reporting periods were trialled further by WPD and Nortech staff. Several snagging items have been identified for closing out prior to the software enhancements being used for BaU.

2.5.3. Modelling & Studies

This activity follows on from the construction of power system and LCT models during the Build phase, and uses the models and data collected from the project to perform future-looking power system studies to help understand the future PQ impacts of LCTs.

Progress within this reporting period

Network models of the two trial areas were developed in the previous reporting periods. These have been updated represent possibly future scenarios for LCT uptakes, with models of LCTs added to estimate the expected voltage harmonic distortion in the future. A report summarising the findings has been produced.

The amount of each LCT type to apply within the models has been estimated for the years 2025 and 2030 under four energy scenarios defined in WPD's Distribution Future Energy Scenarios (DFES).

Rather than studying a single snapshot in time (such as a single maximum demand snapshot, and a single maximum generation snapshot), the PNPQA studies have used a time-based approach where four representative days – winter maximum demand, summer maximum demand, summer maximum generation, and intermediate warm peak demand – are studied for each scenario and year, with each day having power profiles for each load and generator at a half-hour time resolution. This is the same approach used in WPD's Shaping Sub-transmission strategic network planning studies.

As Figure 2-7 and Figure 2-8 show for the Meaford C and Ryeford 33 kV network models respectively, the results of the studies indicate that by 2030 there is the potential for some voltage harmonics to rise above the planning levels (according to ER G5/5). A mix of coincident EV and heat pump demand in the LV network is behind most of the rise in voltage harmonics, as well as solar PV to some extent.

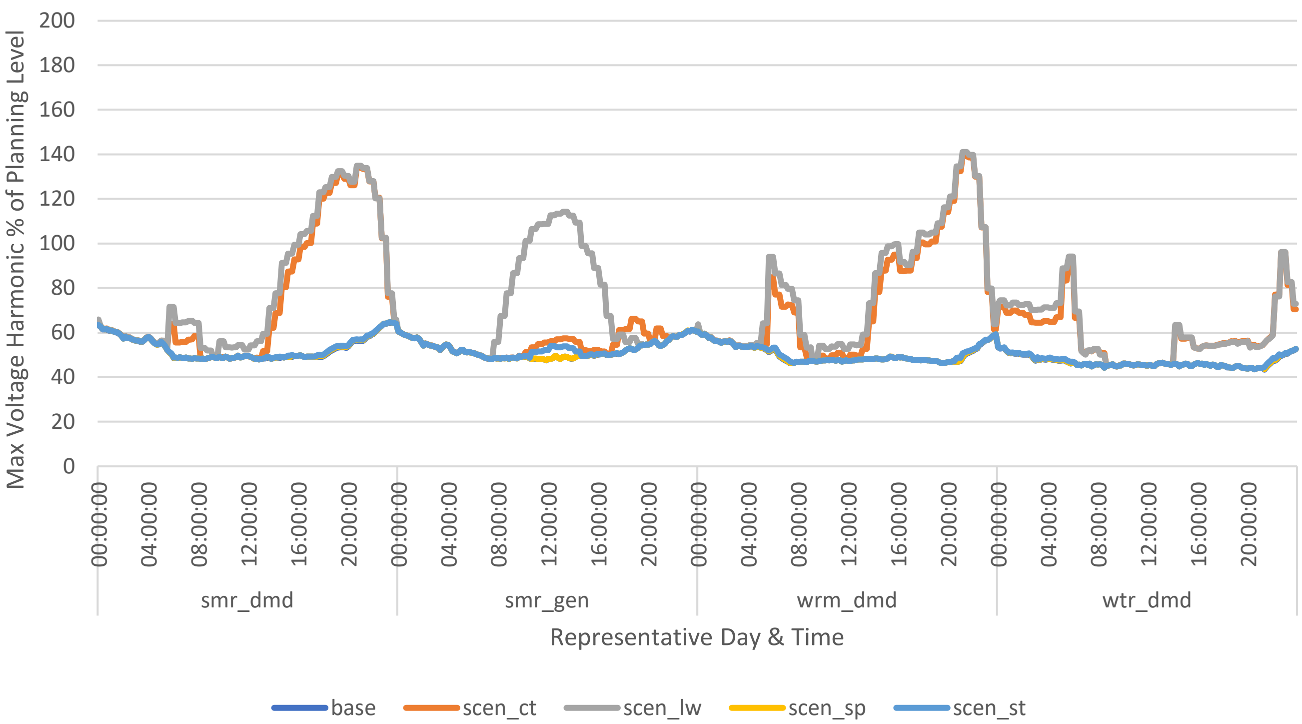

Figure 2-7: Estimated maximum harmonic voltages for the 2030 scenarios in the Meaford C 33 kV network

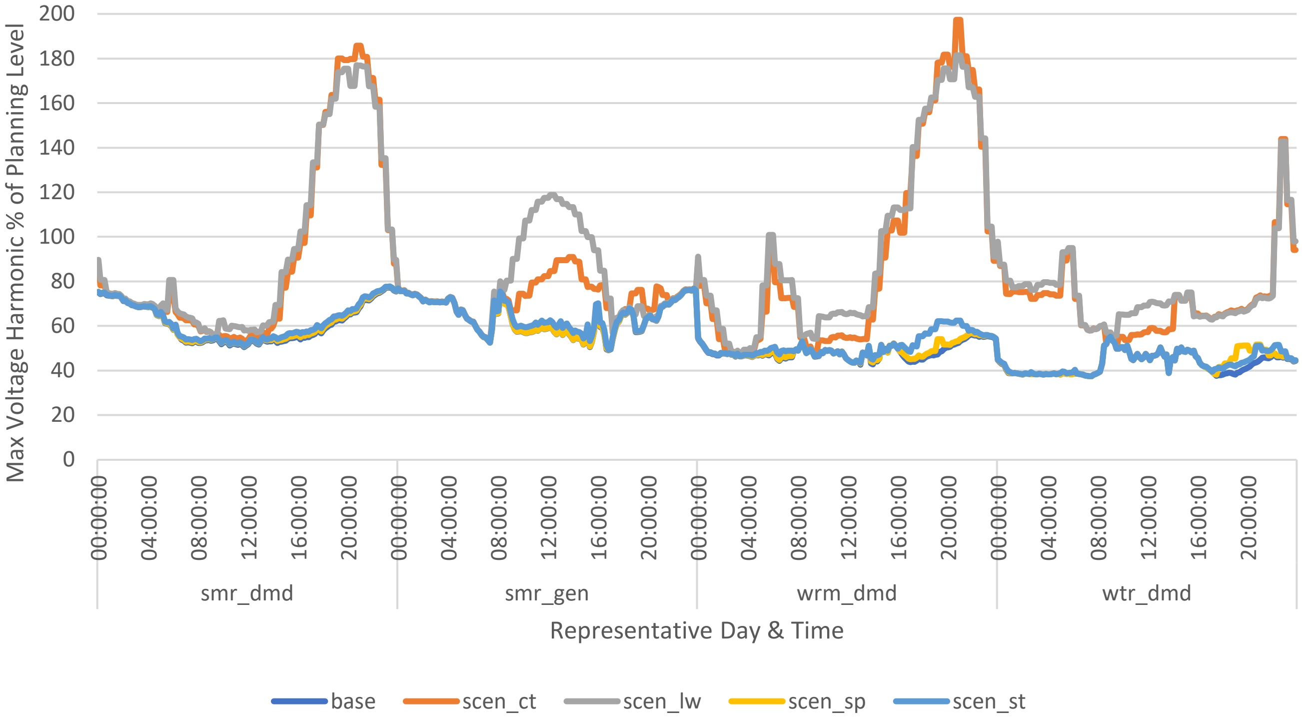

Figure 2-8: Estimated maximum harmonic voltages for the 2030 scenarios in the Ryeford 33 kV network

As well as potential future PQ issues that potentially need mitigation, the study has identified that there is still uncertainty about the PQ impact and uptake of LV connected LCTs on the local LV network but especially on upstream primary networks. This uncertainty is linked to: the apparent stochastic nature of harmonic current emissions, the need to improve the understanding of real life behaviour relating to vector addition of harmonic currents, and the transfer of the aggregated harmonics from LV in to the 11 kV network and above.

This activity is now complete.

2.5.4. Follow-up VT Testing at NPL

The VT testing during the Design phase found that VTs may significantly attenuate higher-order harmonics between their inputs and outputs. Due to the potential significance of the findings, a separate laboratory (NPL) have been engaged to perform follow-up VT testing to confirm the results. This follow-up testing also adds some additional useful features that enhance the potential learning for the project, including testing the influence of other factors such as the burden on the VT secondary circuits and the type of wiring used.

Progress within this reporting period

The VT testing has progressed, with testing including general VT frequency response, linearity, and the effect of different burdens. A report on the VT frequency response and linearity testing is in preparation.

The start of the VT testing was delayed during the initial response to the COVID-19 pandemic, resulting in some testing running over the project's scheduled end date. The final testing will be completed in the next couple of months, enabling the project close down report to be finalised.

2.6. Phase 4: Report

The Report phase is the last phase of the project and includes developing policies for Business-as-Usual (BaU) adoption of the project's findings, dissemination of findings through events, and preparation of the close-down report.

2.6.1. Policies for Business-as-Usual Adoption

This activity involves drafting policies to allow the project's methods and findings to be adopted in BaU operations. Two policies are planned to be developed: 1) a Standard Technique on PQ monitor installations, and 2) a Standard Technique on PQ data analysis.

Progress within this reporting period

A Standard Technique on PQ monitor installations was drafted during a previous reporting period. A second Standard Technique, on PQ analysis using the software tools developed during the project, has been drafted.

2.6.2. Dissemination of Findings

This activity involves preparing technical papers, presenting findings at events, and arranging and delivering project-specific dissemination events.

Progress within this reporting period

During the present reporting period, three technical papers have been developed and submitted for the CIRED 2021 conference. A webinar was arranged through CIGRE UK to disseminate the project's findings on PQ data, and through the ENA's power quality and EMC working group to disseminate the PQ data analysis platform developed through the project.

2.6.3. Close Down Report

This activity involves the drafting, review, revision, and release of the project's Closedown Report.

Progress within this reporting period

An initial draft of the close down report has been produced. This draft will be updated and finalised once the follow-up VT testing is complete.

2.7. Next Steps

All project activities have now completed, except for the follow-up VT testing, which shall be completed shortly after this reporting period. The project close-down report has been drafted, and once the follow-up VT testing is complete the close-down report can be completed and submitted.

3. Progress against Budget

Table 3-1 summarises the details of the progress that has been made with respect to the project budget

Spend Area	Budget (£k)	Expected Spend to Date (£k)	Actual Spend to Date (£k)	Variance to expected (£k)	Variance to expected %
Nortech Contract	£635,400	£635,400	£635,400	£0	£0.0%
WPD Project Management	£45,679	£45,679	£76,333	£30,654*	67.1%
Hardware & Software Requirements	£553,825	£553,825	£550,150	(£3,675)	-0.7%
Network Services Costs	£0	£0	£3,253	£3,253*	N/A
Contingency	£123,490	N/A	£33,907 this is already included in overspend above	N/A	N/A
TOTAL	**£1,358,394**	**£1,234,904**	**£1,265,136**	**£30,232**	**2.4%**

Table 3.1 Project Finances

Comments around variance

WPD Project Management – Increase in costs due to change over of project managers after the project had begun, extra days spent for new project manager to familiarise themselves with the project, more project management days were required than anticipated, utilised contingency to cover these additional costs..

Hardware & Software Requirements – variance due to slight discounts on equipment when ordering high volumes, slightly less spend required as a result.

Network Services Costs – We utilised contingency budget to cover these additional costs as some sites required Network services teams and 3rd party contractors to install.

Contingency – *£33,907 of contingency used to cover additional costs for project management and to cover the extra costs incurred by network services.

4. Progress towards Success Criteria

The project achieved the following in fulfilment of the originally stated success criteria:

Success Criteria	Status
Impact of LCTs on power quality and harmonics within primary networks better understood	**Complete** - All PQ monitors for the wide scale trial of communicating PQ monitors were installed. These monitors provided detailed data on the power quality within primary networks including the impact of LCTs.
Power quality monitors installed at trial locations and remote retrieval of data successfully demonstrated	**Complete** - All 46 PQ monitors for the project's trial were installed, data was successfully remotely retrieved from all installed PQ monitors
Tools for automating power quality data retrieval and analysis demonstrated	**Complete** - Six main features of the PQ analysis automation software were specified, developed, and deployed to the project's data server. Two additional reporting features (an EN 50160 compliance report and an ER G5/5 background report) were specified, developed, and deployed also.
Policies created to implement project outputs in WPD's business	**Compete** - Standard Techniques on PQ monitoring installs and PQ data analysis have been drafted.

5. Learning Outcomes

The learning across different areas of Phases 3 (Trial) and 4 (Report) during the current reporting period is summarised below:

Area	Learning Generated
LCT PQ impacts	Comparing PQ during LCT operation and during outages is a very straightforward way to understand the PQ impact of a specific LCT, but realistically this can only be achieved through constant monitoring.
LCT PQ impacts	The influence of LV connected LCTs, such as heat pumps and electrics vehicles, on higher voltage networks (e.g. Primary Networks at 33 kV) is still uncertain, and could be a major source of PQ issues as the uptake of LV-connected LCTs accelerates.
PQ data analysis	Most PQ monitoring is based on average measurements taken every 10 minutes. However, having some measurands (e.g. voltages and currents) also available at higher sampling intervals and with minimum and maximum aggregates was found to be useful in understanding device behaviour (e.g. short term variations in solar PV power output) and for observing network faults (e.g. by looking for short-term spikes in current and dips in voltage).
PQ data analysis	For offline analysis of large PQ datasets, using the hierarchical data format (HDF) rather than CSV or spreadsheets allowed for much more efficient storage and retrieval of data, and easy integration in to automated analysis scripts.
VTs for harmonic monitoring	33 kV and 11 kV VTs pass through signals at the harmonic frequencies typically measured (up to the 50th) but introduce attenuation in the output magnitude at higher frequencies.
VTs for harmonic monitoring	Close attention must be paid to the frequency response of the measurement system in addition to the VT under test, as this can influence the results. Calibration of the equipment at harmonic frequencies is vital in addition to calibration at the fundamental frequency.
VTs for harmonic monitoring	The ability of 3-phase VTs to transfer triplens harmonics – which typically are in phase – varies significantly depending on the construction of the VTs.
PQ Trial Data Analysis Report:	This report presents an analysis of power quality (PQ) data gathered during the trial of communicating PQ monitors within our Primary Networks Power Quality Analysis (PNPQA) project. The data gathered through the project provides a mixed picture with respect to the impact of the LCTs that were monitored. Some LCTs are producing harmonic currents that are significantly affecting voltage distortion within distribution networks, sometimes eroding 50% or more of the planning level margin for particular harmonic orders. The data suggest flicker and voltage unbalance were most influenced by factors external to the LCTs. The report also suggests that single week-long snapshots may be insufficient to capture PQ data that is representative of the prevailing PQ conditions in a network, as substantial variations in PQ measurements have been seen for different week-long periods during the monitoring period.

Area	Learning Generated
PQ Study Results	This report presents the methods and results from network modelling and studies of power quality (PQ). The studies were focused on assessing the potential PQ impacts of increased integration of low carbon technologies (LCTs) up to 2030, particularly those interfaced using power electronics. The studies indicate that by 2030 increased numbers of LCTs will cause increases in some voltage harmonics, and there is a potential that some voltage harmonics will rise above the planning levels defined in the current standards (ENA ER G5/5). In particular, the 17th harmonic was observed to exceed planning levels in both network models; additionally, the 16th exceeded planning levels in the Meaford C network model; whilst for the Ryeford network model, the 18th, 22nd, 23rd, and 50th harmonics all exceeded planning levels. A mix of coincident electric vehicle (EV) charging and heat pump demand in the low voltage (LV) network is behind most of the rise in voltage harmonics, as well as solar photovoltaic (PV) generation to some extent.

6. Intellectual Property Rights

A complete list of all background IPR from all project partners has been compiled. The IPR register is reviewed on a quarterly basis. New foreground IPR has been generated by PNPQA in the following areas

Title	Description	Ownership	Access Location
Methodology and results of VT harmonic response testing.	Relevant Foreground	Nortech/WPD	www.westernpower.co.uk/Innovation/Contact-us-and-more/Project-Data.aspx
Development and application of a methodology for trial area and site selection	Relevant Foreground	Nortech/WPD	www.westernpower.co.uk/Innovation/Contact-us-and-more/Project-Data.aspx
Implementation of interfaces for retrieving PQ data off PQ monitors.	Relevant Foreground	Nortech/WPD	www.westernpower.co.uk/Innovation/Contact-us-and-more/Project-Data.aspx
Requirements and designs for PQ analysis automation software	Relevant Foreground	Nortech/WPD	www.westernpower.co.uk/Innovation/Contact-us-and-more/Project-Data.aspx
Implementation of PQ analysis automation software	Relevant Foreground	Nortech/WPD	www.westernpower.co.uk/Innovation/Contact-us-and-more/Project-Data.aspx

7. Risk Management

Our risk management objectives are to:

- Ensure that risk management is clearly and consistently integrated into the project management activities and evidenced through the project documentation;
- Comply with WPDs risk management processes and any governance requirements as specified by Ofgem; and
- Anticipate and respond to changing project requirements.

These objectives will be achieved by:

- Defining the roles, responsibilities and reporting lines within the Project Delivery Team for risk management;
- Including risk management issues when writing reports and considering decisions;
- Maintaining a risk register;
- Communicating risks and ensuring suitable training and supervision is provided;
- Preparing mitigation action plans;
- Preparing contingency action plans; and
- Monitoring and updating of risks and the risk controls.

7.1. Current Risks

The project trial has now come to an end so there are no current risks associated with this project.

7.2. Update for risks previously identified

The project trial has now come to an end so there are no current risks associated with this project.

8. Consistency with Project Registration Document

The scale, cost and timeframe of the project has remained consistent with the registration document, a copy of which can be found here https://www.westernpower.co.uk/downloads/2039

9. Accuracy Assurance Statement

This report has been prepared by the PNPQA Project Manager (James King) and by WPD Project Manager (Steven Pinkerton-Clark), reviewed and approved by the Innovation Manager (Yiango Mavrocostanti).

All efforts have been made to ensure that the information contained within this report is accurate. WPD confirms that this report has been produced, reviewed and approved following our quality assurance process for external documents and reports.

Glossary

Abbreviation	Term
BaU	Business-as-Usual
CSV	Comma Separated Values
CT	Current Transformer
DECC	Department for Energy and Climate Change (defunct; now part of BEIS)
DFES	Distribution Future Energy Scenarios
FES	Future Energy Scenarios
HV	High Voltage
IPR	Intellectual Property Rights
JSON	JavaScript Object Notation
LCT	Low Carbon Technology
LV	Low Voltage
NIA	Network Innovation Allowance
NPL	National Physical Laboratory
PNPQA	Primary Networks Power Quality Analysis
UoM	University of Manchester
VT	Voltage Transformer
WPD	Western Power Distribution

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