WPD INNOVATION
Transforming the electricity network

OHL (Overhead Line) Power Pointer

NIA Major Project Progress Report

October 2020 – March 2021

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

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Disclaimer

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1. Executive Summary

OHL (Overhead Line) Power Pointer is funded through Ofgem's Network Innovation Allowance (NIA) and has a budget of £1,302,413. OHL Power Pointer was registered in January 2019 and will be complete by January 2022.

OHL Power Pointer aims to aims to trial a device that is capable of self-powering operation to provide real-time voltage, current, directional power flow and conductor temperature information. This information will be used to more accurately assess network operation, such as latent generation output and directional fault detection to more quickly identify the location of faults.

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

1.1. Business Case

Historically, it has been difficult to capture data in overhead networks, due to the construction of the system and the availability of equipment throughout the network to gather data. As we transition from a Distribution Network Operator (DNO) to a Distribution System Operator (DSO), there is an increasing requirement for localised network monitoring to enable and enhance system operation functions. Moreover, improved monitoring could unlock latent capacity, hence leading to more efficient and economical utilisation of the assets.

The connection of distributed generation across all distribution voltage levels has the potential to back-feed into faults. Currently in multi-branched radial or closed-ring networks it is very difficult to pinpoint the specific location of faults, while OHL fault locations tend to be currently identified via manual visual inspections.

Auto-recloser operations are also recorded manually via visual inspections. This is time-intensive for field staff that could be better deployed on other tasks. Moreover, due to operating temperature uncertainties and limited visibility, the control room currently only makes limited use of probabilistic post-fault OHL ratings, thus potentially underutilising the available circuits.

1.2. Project Progress

This is the third progress report. It covers progress from initial registration in December 2018 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 into three phases:

- Design and build – this is the first phase, which included the selection of trial areas and site locations for the test trials and main field trials, functional specifications of the OHL monitoring device and firmware functionality, and detailed design of the iHost user interface;
- Install and trial – this is the current phase, which includes the deployment of Smart Navigator 2.0 sets on 11kV, 33kV, 66kV and 132kV circuits for monitoring and reporting of data to the iHost platform;

- Analysis and reporting – this is the third phase of the project which is running concurrently with the second phase, the results from the test trials have been analysed and reported and the learning resulting from each of the Methods is being produced. This phase includes dissemination events and producing the close down report.

Since the project began (December 2018), the trial area and site selection methodology has been established and the Smart Navigator 2.0 device has been specified and developed as the solution for OHL Power Pointer. Field trials have been carried out in the West Midlands and South West licence area, with devices installed on 11kV, 33kV, 66kV and 132kV circuits. Devices communicate to the iHost monitoring platform periodically (in real-time or once daily, depending on circuit loading) to report operational data from the trial location. Disturbances on the network are monitored by the device and alarms are generated and new events logged in iHost. A total of 100 sets of monitoring devices were installed for the field trials, generating several months of time-series network data.

The project partner has developed a dashboard for the iHost monitoring platform to display information reported from the Smart Navigator 2.0 at trial locations. This includes power flow direction, device health status', conductor temperature, load current magnitude, post-fault OHL rating and a profile of the daily demand on the circuit. Several interactive network diagrams have been imported into iHost to display a schematic overview of the system and the location of the devices on the network.

An evaluation of the time-series data recorded from the PowerOn TSDS (Time Series Data Store) system has been completed, with several recommendations feeding into the modelling and simulation parameters for the state estimation method. A separate report has been issued documenting the detailed findings and recommendations.

The Control team is progressing with the setup of an (Inter-Control Center Protocol) ICCP link between West Midlands PowerOn and iHost to facilitate the transfer of real-time (Supervisory Control and Data Acquisition) SCADA data and enable state estimation simulations for the trial area.

A Power Network Analyser feature has been specified and has been implemented as a new module in iHost. The online feature performs state estimation simulations using pandapower (power systems analysis python package) and the impedance model at defined intervals, it is also able to perform load flow simulations.

The conductor library for the post-fault rating modules has been re-structured to include the updated OHL ratings from our standard technique ST:SD8A/3 and support future policies, several major software changes have been deployed to the West Midlands iHost system.

An interactive symbol for the (Distribution Network Management System) DNMS system, to enable Control teams to have visibility of alarms and routine logging data captured by the OHL Power Pointer solution has been implemented, Adrian Watts (WPD DSO Technology Support Specialist) created the symbols at various voltages and Saranjit Chodda (WPD DSO Technology Support Specialist) assisted with the implementation within PowerOn.

The main trials have commenced, but visibility of the Smart Navigator 2.0 has been limited by the blockage of 4G communications, which was outside of the control of the project. The issue was resolved on 12th February 2021, however it has severely impacted the volume of operational OHL data captured during the main trials.

Reporting and analysis has been carried out for Method 1: Directional Power Flow Detection, the results have been drawn from the dataset obtained from the main trials.

1.3. Project Delivery Structure

1.3.1. Project Review Group

The OHL Power Pointer Project Review Group meets on a quarterly. 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: Steve 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)
- Ben Brewin (Project Manager for Nortech)
- Sid Hoda (Software Development Manager)
- George Gee (Software Developer)
- Frankie Holder (Software Developer)

1.4. Procurement

The following table details the current status of procurement for this project.

Table 1-1: Procurement Details

Provider	Services/Goods	Area of project applicable to	Anticipated Delivery Dates
Nortech Management Ltd	Day-to-day project management and software development	All	December 2018 – December 2021
Nortech Management Ltd	Smart Navigator 2.0 hardware	Test Trials & Main Trials	Delivered November 2019

1.5. Project Risks

A proactive role in ensuring effective risk management for OHL Power Pointer 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 of this report are the current top risks associated with successfully delivering OHL Power Pointer 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 of this report.

2. Project Manager's Report

2.1. Project Background

OHL Power pointer is split into three phases:

- Phase 1: Design and Build (January 2019 – April 2020)
  In this phase, the functionality of the OHL Power Pointer solution is defined for each of the five Methods (directional power flow monitoring, directional power flow estimation, auto-recloser operation detection, directional fault passage indication (FPI) and post-fault rating of overhead lines). The software will be designed and implemented. Network locations will be identified and equipment installation locations selected. In addition, the trials of the various methods will be designed.
- Phase 2: Install and trial (September 2019 – March 2021)
  In this phase, the Smart Navigator 2.0 equipment (for directional power flow monitoring, auto-recloser detection, directional fault passage indication and post-fault rating determination) will be installed and trialled. Initially, 50 sets of devices will be installed to cover the trials of the various Methods. These devices will communicate to Nortech's iHost system for rapid prototyping of the software and support with the solution design. As part of the main trials, an additional 50 sets of devices will be installed, communicating to our own iHost system and the 50 sets installed as part of the initial trials will be transitioned across to our iHost system from web iHost.
- Phase 3: Analysis and Reporting (January 2019 – November 2021)
  In this phase, the results from the trials will be analysed and a report on the learning resulting from each of the Methods will be produced. Results and key learning outputs will be disseminated and policies will be written to facilitate the wider adoption of the OHL Power Pointer solution into our business should we proceed with Business as Usual (BaU) roll-out.

2.2. Project Progress

The project is currently in the second phase (install and trial), with analysis and reporting running concurrently. The following key outputs and milestones have been completed within this reporting period from October 2020 to April 2021:

- A detailed design specification for the Smart Navigator 2.0 dashboard (mimic) has been prepared and approved and the software build has been completed. The dashboard has been implemented in the West Midlands iHost system and available on our network.
- The main software build has been completed and partially deployed to the West Midlands iHost server with additional features to be added at a later stage.
- The main installations have been completed on 24th October 2020, where a further 70 sets of Smart Navigator 2.0 were installed at trial locations on 11kV, 33kV, 66kV and 132kV OHL networks in the West Midlands and South West licence areas with 30 of those within this reporting period, this is in addition to the first 50 sets installed on the network to carry out iHost trials, in total we now have 120 sets of navigators installed on our network. A summary of the allocation of devices deployed for the project is presented in **Table 2-1**.

Table 2-1 – Summary of SN2.0 Deployment for Main Trials

Distribution Voltage	Sets of SN2.0 Installed
11kV	63
33kV	37
66kV	10
132kV	10
Total	120

- The main trials have commenced, but visibility of the Smart Navigator 2.0 has been limited by the blockage of 4G communications as our servers did not have the capability to receive 4G communications, this was outside of the control of the project. The communications issue was resolved on 12th February 2021 after having new equipment installed, planned outages of our radius server and testing, however it has severely impacted the volume of operational OHL data captured during the main trials. 70 sets of the SN2.0 devices are reporting to our servers and the data is available on our intranet, the remaining 50 still have Nortech Sim Cards installed and these are due to be exchanged for our own in the next reporting period.
- CyberArk users and access have been granted to Nortech engineers to allow them to access our servers and interrogate the data being sent to our internal iHost server
- Reporting and analysis has been carried out for Method 1: Directional Power Flow Detection, the results have been drawn from the dataset obtained from the main trials.

2.3. Method 1: Directional Power Flow Monitoring

The transition from a passive network to an active network requires greater visibility of the direction of power flowing through network assets. Connection of renewable distributed generation and unpredictable demand profiles of consumers has resulted in the proliferation of reverse power flows through the network. It is becoming increasingly important to monitor the direction of power flows in order to make informed decisions about switching and network operation, determine reinforcement requirements and network constraints at the planning stage, run real-time analysis to ensure curtailment requirements are accurately determined and ensure ratings of transformers are sufficient, as they are dependent on power-flow direction.

This section outlines the progress that has been made during this reporting period.

Analysis of the test trial data, captured over a year long period, has been carried out and tools have been developed to provide better visibility of the magnitude and direction of power flows through feeders. The tools capture load duration and seasonal trends to inform planning decisions and better understand the direction of power flows through previously unobservable HV feeders.

The performance of the Smart Navigator 2.0 has been well tested through the test trials and preliminary data has been made available from the main trials which shows regular changes in direction of power flows through 66kV and 132kV circuits at main trial locations.

The next steps to be taken are outlined below.

The ICCP link is to be established to provide real-time data from PowerOn to iHost. This will include directional power flow measurements for the Shrewsbury 33kV network and selected 11kV feeders. The sensor data will be used to validate the power flow direction at many of the trial sites.

A stakeholder engagement meeting will be scheduled with engineers invited to attend from the Primary System Design and Control teams to demonstrate the live power flow direction features and discuss the data obtained from the trials which could be a valuable planning resource.

2.4. Method 2: Directional Power Flow State Estimation

Power system state estimation is a method used to provide full visibility of the network based on available measurements. Measurements are typically prone to small errors which can occur in through addition of noise during analogue data transmission or tolerances within the measurement instruments, for example. State estimation offers a method of solving the challenges of network observability by taking erroneous data and calculating a 'best estimate' of the present state of the system using weighted linear regression techniques.

This section outlines the progress that has been made during this reporting period.

State estimation is being trialled on the Shrewsbury 33kV network. OHLs in the Shrewsbury area will be used to validate the performance of the state estimation, confirming power flow direction through circuits.

Site visits have been carried out to each primary substation on the 33kV ring to validate the positions of transformer tap changers against PowerOn records. The configuration of the network was also confirmed for the normal operating arrangement and transformer impedances were updated in the power system models using nameplate data.

The impedance model has been derived from a combination of sources to ensure accuracy. Comparisons were made between the IPSA model and GIS data from EMU to validate the impedances of the circuits, and site visits were undertaken to compare the transformer impedance and tap configuration with the data stored in the IPSA model. Power flow simulations were performed on the model in the PandaPower package and results were validated against the equivalent simulations in IPSA, with satisfactory outcomes.

The model has been finalised and tested extensively offline in python.

A Power Network Analyser feature has been specified and has been implemented as a new module in iHost. The online feature performs state estimation simulations using pandapower (power systems analysis python package) and the impedance model at defined intervals, it is also able to perform load flow simulations.

An ICCP simulator was configured to simulate the behaviour of PowerOn data flowing in real-time over an ICCP link to iHost. The ICCP data is comprised of over 200 binary and analogue datapoints, representative of circuit breaker states, transformer tap positions, MW, MVAr, A and voltage measurements, continuously changing in response to the state of the network. The simulator script captures a total of 138,000 changes to sensory inputs for the trial area over the 6-hour period, it was obtained using the PowerOn TSDS feature.

The Power Network Analyser performed state estimation simulations, converging successfully at 2-minute intervals throughout the period of 6 hours of ICCP data. The results are being analysed and assessed for accuracy.

The next steps to be taken are outlined below.

The Control team is establishing the ICCP link between the West Midlands iHost server and live PowerOn. The bilateral table will be updated to include measurements outside of the Shrewsbury network, to validate other methods. Once implemented, iHost will generate a daily report of data to provide deeper testing of the state estimation module, such as performance under different network operating arrangements.

2.5. Method 3: Detection of Auto-Recloser Operations

Many auto-recloser operations are recorded manually via visual inspections. This is time-intensive for field staff that could be better deployed on other tasks. This method aims to improve the reporting of short-term interruptions to customers and quantify circuit breaker operations to feed into maintenance requirements.

This section outlines the progress that has been made during this reporting period.

The manufacturer issued revised firmware for the Smart Navigator 2.0 to accurately assess the number of operations of auto-recloser circuit breakers during attempts to clear faults. Since the deployment of the firmware to devices at the test trial locations, one fault has been observed on an 11kV circuit from Hereford North primary substation, two circuit breaker operations were detected. This will be validated against a manual reading from the GVR located upstream from the trial site.

The momentary and permanent fault counters, and circuit breaker operations have been incorporated into the SN2.0 dashboard to assist with maintenance efficiency and short-term interruption quantification. The Power Flow Interruptions section of the dashboard is identified in **Figure 2-1**.

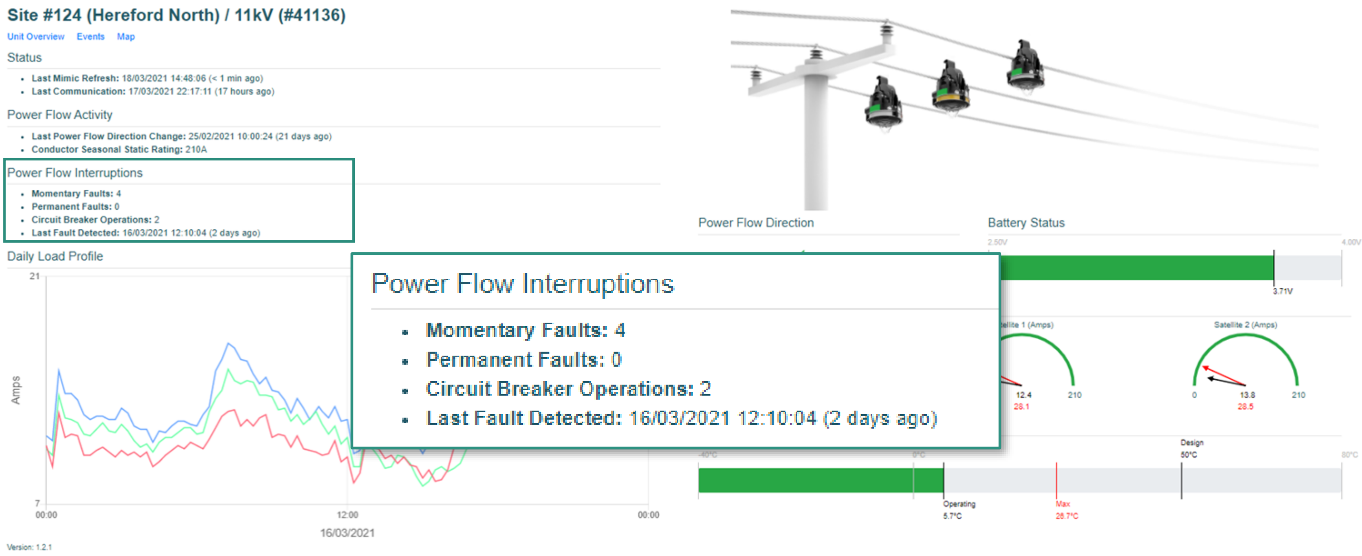


Figure 2-1 – Power Flow Interruptions presented on the Smart Navigator 2.0 dashboard

The next steps to be taken are outlined below.

Fault activity will be monitored for the duration of the main trials and activity counters will be validated against records from auto-reclose equipment, some of which can be obtained remotely, many of which require a manual reading. A stakeholder engagement meeting will be scheduled to demonstrate the automated recording of circuit breaker operations, a review of the policy documentation for maintenance activity will be undertaken and the business case will be updated accordingly.

2.6. Method 4: Directional Fault Detection

The connection of distributed generation, across all distribution voltage levels has the potential to back-feed into faults. Currently in multi-branched radial or closed-ring networks it is very difficult to pinpoint the specific location of faults, while OHL fault locations tend to be currently identified via manual visual inspections. This Method aims to detect the direction of passage of fault currents.

The Smart Navigator 2.0 at main trial site #232 detected a 3-phase-earth fault during the night of 11th March. The device is installed adjacent to pole 74QBNA52. Network Services confirmed the fault was caused by a tree collapsing on the OHL section between 74QBNA67 and 74QBNA68, which is approximately midway (geographically) between trial site #232 and Leominster substation. The fault location is indicated on the schematic presented in

Figure *2-2*.

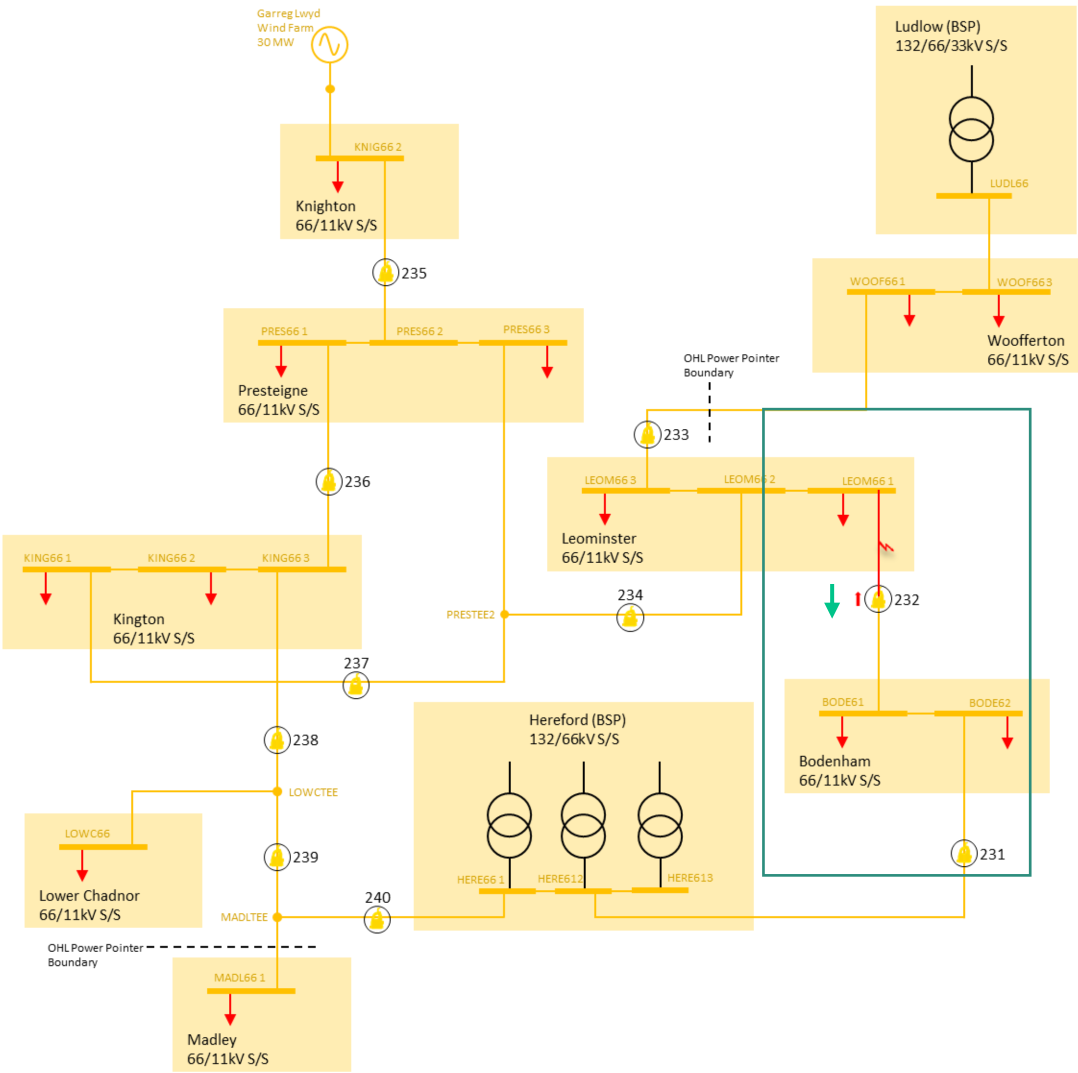


Figure 2-2 – Directional fault passage indication on the Hereford 66kV network

The circuit outage lasted for several hours before power was restored. The Smart Navigator 2.0 correctly determined the direction of fault current, as indicated by the red arrow pointing towards the fault on the schematic.

It is hypothersised that the fault location been between the trial site and Bodenham substation the Smart Navigator 2.0 would likely have indicated fault current passage in the green direction, given the normal meshed running arrangement with Ludlow and parallel circuits to Hereford BSP.

This case demonstrates the advantages of directional fault passage indication in meshed systems, such as the 33kV and 66kV networks.

The next steps to be taken are outlined below.
Figure 2-2) shall be updated to include an arrow indicator to display the direction of fault current, during and after detection of a fault event.

The SN2.0 symbol has been implemented in PowerOn and the benefits of directional fault detection shall be reviewed and captured in the updated business case. This is dependent on faults occurring during the main trial period.

2.7. Method 5: Conductor Temperature Monitoring

Due to operating temperature uncertainties and limited visibility, the control room currently only makes limited use of probabilistic post-fault OHL ratings, thus potentially underutilising available capacity of circuits. This method aims to implement a post-fault OHL rating algorithm based on real-time conductor temperatures.

The post-fault rating algorithm is based on the theory presented in CIGRE Technical Brochure 601[1] , Appendix E.3 (Temperature tracking calculation), which has been adapted to include conductor temperature as an input parameter. The methodology considers the adiabatic heating of a conductor to determine the magnitude of continuous current required to bring the temperature of the conductor from its operating temperature to its maximum operating temperature over a user-definable period (10 minutes by default).

The following progress has been made within this reporting period.

The post-fault ratings algorithm has been updated to capture the changes documented in our Standard Technique: ST:SD8A/3, which was revised in February 2020 to reflect the review of ENA Engineering Recommendation P27. The main changes include the addition of static pre-fault and post-fault ratings and the redefining of seasonal boundaries.

The conductor library was re-structured to include the updated OHL ratings from ST:SD8A/3 and support updated future policies, the changes have been deployed to the West Midlands iHost system.

Ten sets of Smart Navigator 2.0s installed on the 132kV K-Line in the South West licence area have been updated with the latest firmware and configuration over-the-air to assess the temperature-based post-fault ratings method. The location of the K-Line in an exposed coastal area of the South West, and the capacity of distributed intermittent generation connected to the double circuit provides a comprehensive test case for the method.

The first week of data has been extracted from the main trials dataset for the device installed at trial location #241, adjacent to Alverdiscott Grid Supply Point (GSP). The data is presented in Figure 2-3. The preliminary results indicate an increase in capacity headroom of the circuit, for a limited period during post-fault conditions. A more detailed assessment of the performance will be undertaken once seasonal influences have been captured in the dataset.

[1] CIGRE Technical Brochure 601, '*Guide for Thermal Rating Calculations of Overhead Lines',* December 2014

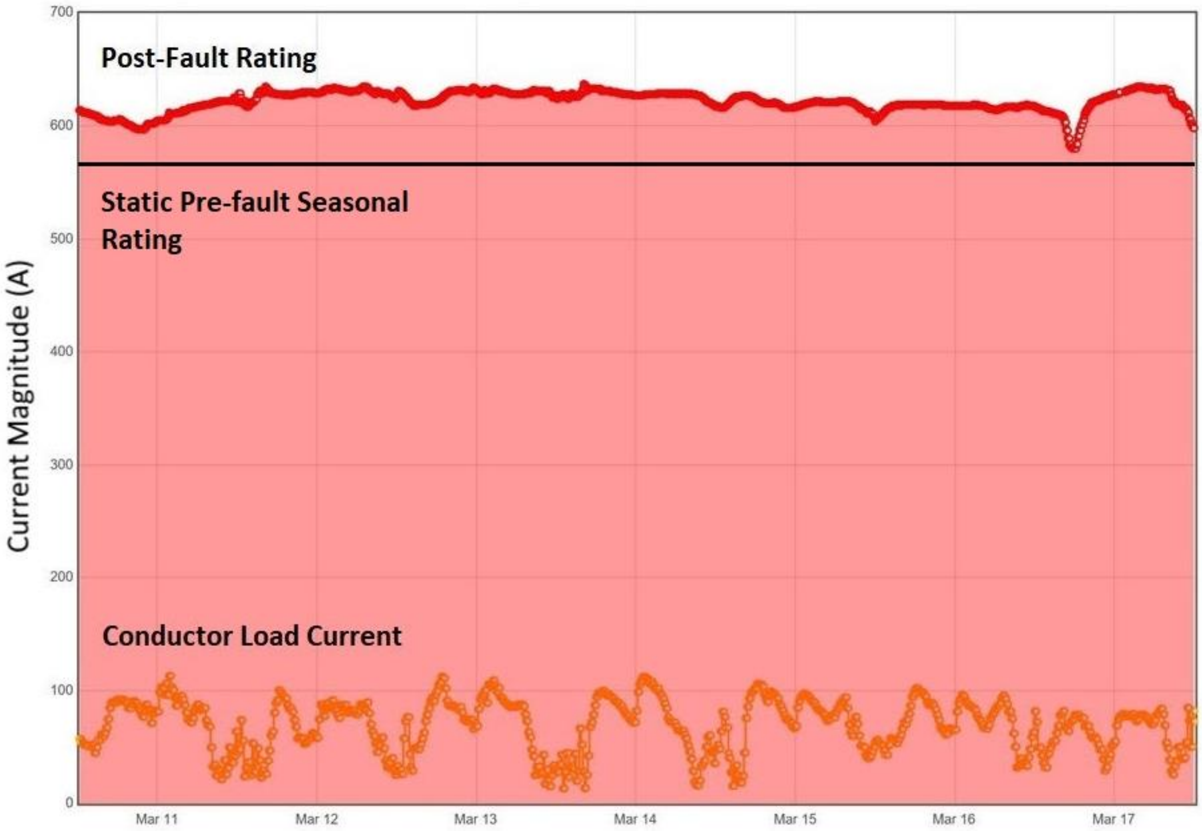


Figure 2-3 – Post-fault rating determined at trial site #241 (132kV K-Line)

The next steps to be taken are outlined below.

A stakeholder engagement meeting will be scheduled with engineers from Policy and Control invited to attend, to demonstrate the performance and the findings of the method.

The project team will explore the feasibility of incorporating dynamic OHL ratings into Active Network Management schemes to relieve constraints on generators.

The team will also explore the applicability of a 'risk of exceedance' factor to determine whether further headroom could be introduced into the circuit capacity during post-fault conditions.

3. Progress against Budget

Table 3-1: Progress against Budget

Spend Area	Budget(£k)	Expected Spend to Date (£k)	Actual Spend to Date (£k)	Variance to expected (£k)	Variance to expected %
WPD Project Management Costs	£65,067.00	£50,468.93	£63,185.00	+£12,716.07	+25.2%
Nortech Project Management Costs	£1,049,960.00	£805,700.00	£805,700.00	-	0%
Network Services Costs	£31,384.00	£24,896.56	£22,769.00	-£2,128	-8.5%
Equipment and Testing Costs	£39,000.00	£39,000.00	£31,571.00	-£7,429	-19%
Contingency (10%)	£118,478	N/A	N/A	N/A	N/A
Total	**£1,303,889**	**£920,065**	**£923,225**	**+£3,160**	**+0.3%**

Comments around variance

WPD Project Management Costs – overspent due to increased work liaising with Network Services teams in multiple areas and having to re-schedule installations due to the COVID-19 pandemic. Change request is under internal review and expected to be approved in the next reporting period.

Equipment and Testing Costs – PEN testing was carried out internally with our Cyber Security team instead of contractors, reduced costs for the testing, the CyberArk user accounts have been created and the costs were less than expected and no server upgrades were required, may need to renew licenses which will fulfil the sanction amount.

Network Services Costs – this variance is due to the delay of main installations and therefore delaying the work to swap out Nortech sim cards, these costs will be allocated as planned within the remainder of the project.

4. Progress towards Success Criteria

Table 4-1 documents the progress of the project towards the Success Criteria.

Table 4-1 – Progress towards Success Criteria

Criteria Number	Success Criteria	Progress
1	Power flow direction determined correctly at a minimum of 10 sites across 11kV and 33kV networks	Complete – power flow direction successfully determined at over 100 site locations on 11kV and 33kV networks
2	Power flow direction estimated correctly at a minimum of 10 sites across 11kV and 33kV networks	Complete - power flow direction estimated correctly at 10 sites across the 33kV network. Further data being captured to evaluate the effectiveness of the solution with different network configurations.
3	Correct detection of a minimum of 5 auto-recloser operations during the project lifetime (recognising this is dependent on faults occurring)	Complete - correct detection of more than 5 auto-recloser operations during the project lifetime. Further data being captured to evaluate the effectiveness of counting individual circuit breaker reclose actions.
4	Direction of passage of fault current determined at a minimum of 5 sites during the project lifetime (recognising this is dependent on faults occurring)	Complete – direction of fault passage for 36 fault events during the test trial period.
5	Post-fault ratings determined for at least one circuit at or above 33kV during the project lifetime	Complete – sensors at 10 test trial locations on the 132kV network demonstrating real-time conductor temperature-based post-fault rating of conductors.
6	Completion of trials of the five different Methods, with a report on each Method detailing the learning and updated business case for wider business adoption	In progress – interim reports prepared for one of the five different Methods, with the others due in the next reporting period. Final reports to include analysis of extended main trail data and updated business case for wider business adoption.
7	Development of policies to facilitate the wider business adoption of the technology at the end of the project should WPD decide for BaU adoption	In progress – policy for use of live-line techniques for installation of monitoring devices on 11kV and 33kV networks updated.

5. Learning Outcomes

The project has generated the following learning:

Installations of the SN2 devices was quick and efficient using live line techniques following company policies and procedures, however, installations on 33kV to 132kV was increasingly difficult due to the requirement to isolate and earth the overhead lines to carry out the installations.

11kV – these were very easy to install using long stick techniques, our policies allow for the installation of monitoring devices at 11kV to be carried out using live line techniques, we could install between 5 and 10 sets per day with the only time constraint was travelling between sites.

33kV – this proved the most difficult to install due to the requirement to isolate and earth each location where a set of navigators were to be installed, we had our control room cancel some shutdowns due to poor weather and security of supply can be affected by isolating a 33kV feeder. Discussions with our policy engineers and our safety department lead to a change in live line policy to extend the live line techniques up to 33kV for installing monitoring devices, this came into effect in January 2021.

66kV – this was fairly straightforward as there isn't much 66kV in our areas and where we needed to install was done so with the help from local teams who made the network safe for the installations.

132kV – this was difficult due to the fact that these devices cannot be installed using live line techniques and could not justify the outage to install, after speaking to major projects engineers we decided to utilise an already approved outage for tower painting etc. to install the monitoring devices, this lead to the sites varying depending on availability of the outage, we ended up installing the navigators on the K-Line in the South West due to the outage but also it is a thermally constraint line with lots of generation connected to it.

After monitoring the installations of the navigators, it became increasingly clear that the middle phase on an overhead line had the least amount of current flowing through it at 11kV, this could be related to single phase tee off spurs connected to the two outer phases, the master navigator needs sufficient load current to keep the batteries charged so we changed our approach to place the master unit on the outer phases as it used more power than the slave devices. The real-time conductor-temperature based post-fault rating method has been trialled, preliminary learning suggests an improvement in capacity headroom where deployed on 33kV, 66kV and 132kV circuits, utilising real time conductor temperature readings and comparing that to our seasonal; conductor ratings, we are able to calculate an increase in post fault ratings potentially allowing more generation to be connected

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 OHL Power Pointer in the following areas:

IPR	Ownership
Architecture for the OHL Power Pointer Solution	WPD / Nortech
Policies for the installation and location of equipment	WPD
Functional specification for the OHL monitoring device	WPD
Functional specification for the power flow direction estimator	WPD
Functional specification for the post-fault rating system	WPD
Data generated through test trials	WPD
iHost software: UI representing direction of power flow	Nortech
iHost software: Real-time post-fault ratings module	Nortech

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 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 OHL Power Pointer risk register is a live document and is updated regularly. There are currently 26 live project related risks. Mitigation action plans are identified when raising a risk and the appropriate steps then taken to ensure risks do not become issues wherever possible. In Table 7-1, we give details of our top five current risks by category. For each of these risks, a mitigation action plan has been identified and the progress of these are tracked and reported.

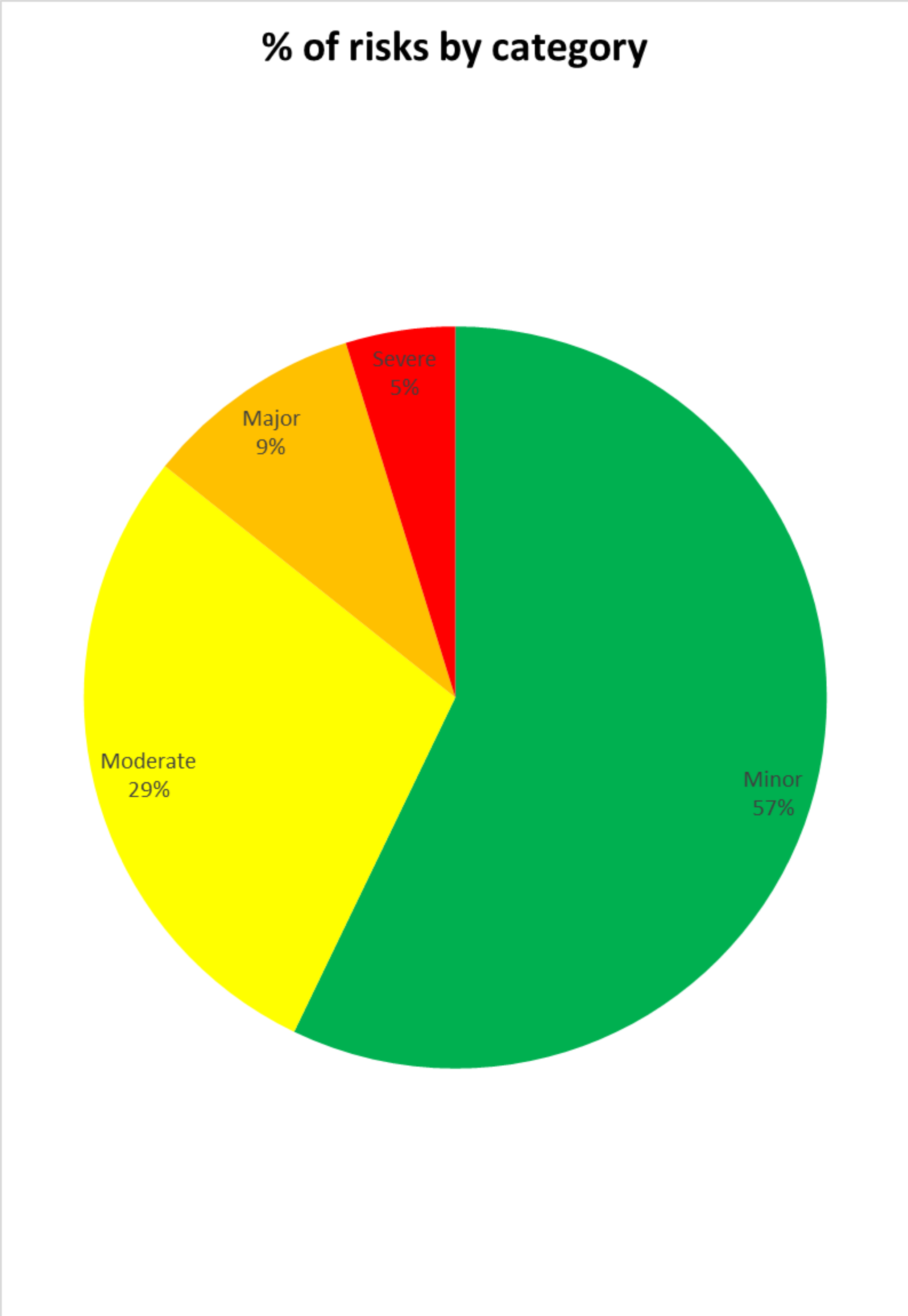
Table 7-1: Top five current risks (by rating)

Details of the Risk	Risk Rating	Mitigation Action Plan	Progress
Main trials dataset does not provide sufficient quantity of data for thorough analysis of the OHL Power Pointer solution	Severe	Project extension granted to accommodate extended duration of main trial period	This risk is being monitored, reporting will run concurrently with main trials but an extension may still be required
Device does not comply with regulations	Major	Design to international standards, identify standards before technical specification stage	Functional specification approved by WPD, FAT approved by WPD, compliance documentation pending, PEN testing kick-off imminent
WPD resources unavailable	Major	Empowering Nortech to act on WPD's behalf to gain	Ongoing

		business/stakeholder input. Detailed analysis of data obtained from field trials to continue to avoid any delay to the project.	
Lines team is electrocuted replacing sim cards and maintaining the Smart Navigator 2.0 device	Moderate	Implement safe systems of work, install equipment on deactivated lines where appropriate	Using approved techniques
Smart Navigator 2.0 devices removed from OHL by Network Services teams	Minor	Demonstrate technology to Network Services teams during installations. Patches in PowerOn to be provided for each location of a set of devices, to ensure field staff are aware of equipment during fault location activities	One set of devices removed and later recovered. Network Services unsure of how/why this happened.

Likelihood = Probability x Proximity						
	Certain/Imminent (21-25)	0	0	0	0	0
	More likely to occur than not/Likely to be near future (16-20)	0	0	0	0	0
	50/50 chance of occuring/ Mid to short term (11-15)	1	0	0	0	1
	Less likely to occur/Mid to long term (6-10)	0	5	0	1	1
	Very unlikely to occur/Far in the future (1-5)	0	2	4	3	3
		1. Insignificant changes, re-planning may be required	2. Small Delay, small increased cost but absorbable	3. Delay, increased cost in excess of tolerance	4. Substantial Delay, key deliverables not met, significant increase in time/cost	5. Inability to deliver, business case/objective not viable
		Impact				

	Minor	Moderate	Major	Severe	
Legend	**12**	**6**	**2**	**1**	**No of instances**
Total	**21**				No of live risks


% of risks by category
Severe
5%
Major
9%
Moderate
29%
Minor
57%

7.2. Update for risks previously identified

Descriptions of the most significant risks, identified in the previous six monthly progress report are provided in Table 7-2 with updates on their current risk status.

Table7-2: Risks identified in the previous progress report

Details of the risk	Previous risk rating	Current risk rating	Mitigation Action Plan	Progress
Remote communications from devices to iHost cannot be established	Major	Moderate	SN2.0 contains modem with 4G capability and 2G fallback, Global System for Mobile Communications (GSM) surveys carried out at each site	4G communications blockage resolved
Device does not comply with regulations	Major	Major	Product designed to international standards; standards identified before technical specification stage	Functional specification and FAT approved by WPD, PEN testing pending
Planned outages at 33kV, 66kV and 132kV (during device installation window) are rescheduled / cancelled	Major	Closed	Strategic planning of field trials by location, avoiding areas where there is limited alternative (N-1) capacity	Field and main trial installations complete, additional units being installed
WPD resources unavailable	Major	Major	Empowering Nortech to act on WPD's behalf to gain business/stakeholder input. Detailed analysis of data obtained from field trials	Analysis and software build activities to continue using data from field trials, additional hardware installations ongoing

Candidate circuits selected are not available for planned outage	Major	Closed	Outage planning for installations is one of the primary constraints in the site selection criteria	33kV live line techniques approved, discussions to schedule installations at remaining sites ongoing

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/25963.

9. Accuracy Assurance Statement

This report has been prepared by the OHL Power Pointer Project Managers (Ben Brewin and Steve 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. We confirm that this report has been produced, reviewed and approved following our quality assurance process for external documents and reports.

Glossary

Abbreviation	Term
APN	Access Point Name
BAU	Business as usual
DG	Distributed Generation
DNMS	Distribution Network Management System
DNO	Distribution Network Operator
FEP	Front End Processor
FPI	Fault Passage Indicator
GB	Great Britain
GSM	Global System for Mobile Communications
GVR	Gas-filled Vacuum Recloser
HV	High Voltage
ICCP	Inter-Control Centre Communications Protocol
IPR	Intellectual Property Register
LCT	Low Carbon Technologies
LV	Low Voltage
NIA	Network Innovation Allowance
OHL	Overhead Line
SN2.0	Smart Navigator 2.0
TSDS	Time Series Data Store
WPD	Western Power Distribution

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