SIF Round 3 Project Registration

Date of Submission

May 2024

Project Reference Number

NPG_SIF_010

Initial Project Details

Project Title

Gridlink

Project Contact

Chris Goodhand

Challenge Area

Novel technical, process and market approaches to deliver an equitable and secure net zero power system

Strategy Theme

Net zero and the energy system transition

Lead Sector

Electricity Distribution

Other Related Sectors

Electricity Distribution

Project Start Date

01/03/2024

Project Duration (Months)

3

Lead Funding Licensee

NPg - Northern Powergrid (Northeast) Limited

Funding Licensee(s)

NPg - Northern Powergrid (Northeast) Limited

Funding Mechanism

SIF Discovery - Round 3

Collaborating Networks

Northern Powergrid

Technology Areas

LV & 11kV Networks

Project Summary

GridLINK seeks to demonstrate the use of a Digital Support System (DSS) to optimise the placement and network running arrangements of smart switches which dynamically link multiple LV feeders at multiple points on the LV network. The DSS will determine the running arrangement and placement based on number of network scenarios such as enabling more connections, improving access to low voltage flexibility, and network reliability providing more capacity and resilience to support in their customers' net-zero journeys.

Add Third Party Collaborator(s)

Kelvatek

Project Budget

£134,925.00

SIF Funding

£131,925.00

Project Approaches and Desired Outcomes

Problem statement

In the UK, the adoption of low-carbon technologies (LCTs) like PV, heat pumps, and electric vehicles is reshaping the energy landscape, offering benefits such as reduced emissions, lower energy costs, and increased self-sufficiency. However, this transition poses challenges. Consumers now depend on the energy grid not only for lighting and device power but also for heating and transportation, raising concerns about grid vulnerabilities during failures or demand surges. Consumer behaviour, influenced by incentives like time-of-use pricing and demand response programmes, will cause fluctuations in grid loads, challenging the adaptability of the low voltage network. Balancing sustainability and grid stability is an ongoing challenge requiring infrastructure upgrades and innovative solutions.

One explored solution is dynamic meshing and un-meshing of the low voltage network. However, grid complexity arises from the dynamic interconnection of various elements, and this process introduces technical intricacies demanding robust technological solutions and grid visibility.

Despite challenges, the journey towards a more efficient and resilient energy grid is transformative. Insights from previous projects serve as stepping stones to seamlessly integrate LCT, empower consumers, and maintain reliability and affordability.

GridLINK addresses these challenges by introducing a novel digital support system using existing technology like underground smart switches and above ground vacuum circuit breaker technology. It aims to connect low voltage feeders at multiple points on the same substation, differing ones, and leverage an automatic decision support system to optimise device placement and suggest switching arrangements for various scenarios. This creates a connected web of LV assets, optimally spreading load utilisation and promoting LCT connection by freeing up local capacity.

The dynamic, flexible LV network enables low voltage flexibility markets as more consumers adopt LCT with import and export capabilities. It addresses uncertainty

network operators face in tracking distribution energy scenarios, allowing configuration based on forecast pathways.

Discovery phase activities include creating a cost-benefit model using Northern Powergrid data to identify additional LCT customer connections without reinforcement needs, compatible LV network areas, and the project's role in decarbonisation and LV flexibility markets. The project also assesses financial benefits, network visibility, reliability, and data points needed for a Decision Support System. It identifies suitable trial areas and opportunities to increase network connectivity. In later phases it may also examine the role iDNO can play in such a scheme.

Video Description

http://www.youtube.com/watch?v=F8r2mHMLOcs

Innovation justification

The core innovative aspects of the GridLINK project lie in its transformative approach to addressing challenges associated with the adoption of low carbon technologies (LCT) in the UK's energy landscape.

1. Decision Support System for Optimisation of Placement of Smart Switches and Network Running Arrangements
2. Connectivity of Low Voltage Feeders
3. Exploration of iDNO Roles and Increased Interconnectivity
4. Foundation for Low Voltage Flexibility Markets
5. Addressing Uncertainty with Future Energy Scenarios
6. Data-Driven Decision Making

7. Enhanced Network Visibility and Reliability

GridLINK Utilises a novel digital solution to provide a Decision Support System, a Network Asset Deployment tool and new to market hardware that when used in tandem will allow configurable LV networks for optimal connection of over utilised and underutilised feeders for the same ground mounted substation and the optimal switching arrangements to be maintained enabling more LCT connections.

This project is innovative because releasing capacity in this way, coupled with advanced modelling and supported by an ongoing Digital DSS has not been demonstrated, coupled with the potential for interconnectivity between DNO/iDNO.

This project is is not appropriate for price control funding and risky: The combination of participants, technology along with the determination of linked feeders and optimal switching arrangements are novel and require demonstration. The project builds on multiple innovation projects in the past that have demonstrated both the value of meshing substations at the low voltage for sharing load across substations such as LV FUN and Smart Street. Those projects explored the benefits of network meshing at the LV level including load spreading and voltage regulation, but not at the feeder level and not potentially between DNO/iDNO.

The counterfactual to this solution is traditional reinforcement and costly cable overlay schemes which will deliver the required capacity, but importantly increase consumer bills, leave less flexibility in the network and cause consumer disruption.

The risks we are seeking to address is the forecasted steep increase in LCT connection and other associated load growth, the lack of configurability at by utilising novel new digital solutions to determine the optimal placement and running arrangements of hardware that allows multiple connection points between LV feeders, and establish capacity release by spreading load from feeders that are above average utilisation to below average utilisation.

Impacts and benefits selection (not scored)

Financial - future reductions in the cost of operating the network

Environmental - carbon reduction – indirect CO2 savings per annum

Revenues - improved access to revenues for users of network services

New to market – products

New to market – processes

New to market - services

Impacts and benefits description

Gridlink will deliver the following benefits to consumers:

1. Reduced socialised costs of infrastructure expenditure will be realised through a reduction in peak energy consumption. These benefits will be quantified against the counterfactual for each locality where the solution is deployed and will include Network operator costs for any network upgrades required.

2. Accelerating the decarbonisation of the network by reducing losses this will be achieved by spreading load between LV feeders. This will be quantified by analysing the measured output of power quality sensors embedded within the technology, calculating the losses avoided and converting this to a carbon saving benefit.

3. Increasing LV flexibility market participation by making the network more configurable and controllable relaxing thermal constraints on underground cables which could make calling on consumers to respond to a local constraint impractical and accelerate asset degradation.

4. Increased network reliability -- The technology that is utilised by the trial can also be utilised to sectionalise faulting parts of the network, protecting many customers (including vulnerable) from the impacts of overloads or fault condition and provide fault locations to the Network Operator to allow for the quicker resolution of faults.

These benefits will be delivered through enabling a configurable connected network of feeders connected to the same ground mounted substation, paired with a Decision Support System that allows for optimal switch configuration for several scenarios to be considered. We will also consider how iDNO's can be interconnected with ONO networks where appropriate.

A full cost benefit analysis will be performed in the discovery phase but a high level assessment carried out shows the potential for 1744 km of low voltage cable deferred if the solution was deployed on 10% of Northern Powergrid ground mounted substations, which will be scaled to include the entire GB network as part of the CBA in the discovery phase and the enablement of quicker connection of LCT due to the release of additional hosting capacity.

In terms of carbon savings if the solution was applied to 10% of Northern Powergrid GM substations the carbon saving could be as high as 13,306 KtCO2e up to 2040.

Teams and resources

NPG has a pre-existing relationship with Kelvatek from previous innovation projects and as a supplier of network fault management systems. NPG acknowledges Kelvatek's expertise in network-based management technologies, digital systems, analytic tool development, and a strong delivery record on network innovation projects across several DNOs. Kelvatek's deep insight into the UK electricity network positions them well to assess risks, opportunities, and barriers to the implementation and viability of wide-scale solutions.

NPG role will be as technical advisor across all WPs and will provide key information on typical network-based use cases. NPG bring extensive knowledge of their network, other networks and LV control procedures plus an expanding portfolio of flexibility based developments.

Kelvatek have partnered with Distribution Network Operators to deliver revolutionary new technologies to the energy market for decades. Many of our solutions are formed from a synthesis of hardware, software and services to provide real value.

Our role in the project is to deliver the GridLINK CBA and the output of learnings from the defined data use cases. The predominant work allocation is made up of network modelling and digital product design with this in mind the following resource roles are needed for the Discover Phase.

- Business Analyst
- Future System Engineer
- Data Engineer
- Data Scientist
- Powerflow Engineer Specialist
- Business Development & Innovation
- Project Manager

In terms of experience with digital solutions Kelvatek have been delivering AI/ML applications that benefit the network since 2016. This work includes load categorisation, optimal equipment deployment, pre-fault, cable health and loss categorisation to name a few. We also have a dedicated data ingestion and AI/ML data platform data bricks this allows for rapid development of data use cases, easy visualisation and acts as a store for the huge amount of load, fault and asset health data we collect from devices in the field. We have a Machine Learning

Centre of excellence where our team of data scientist, systems architects and data engineers work to analyse data and work in partnership with out customer to create new data use cases.

The resources equipment and facilities are all on site at Kevlatek facilities with no external access needed to any other services, we even have our own low voltage rest network although we do not envisage this will need to be utilised for this project.

Project Plans and Milestones

Project management and delivery

Approach to project management: Kelvatek employs a structured project management approach overseen by a Project Manager. It follows a three-stage process: Product Innovation, Product Development, and Product Operationalisation, aligned with commercial milestones. This approach combines elements of PMBOK, PRINCE2, and Agile frameworks.

The Project Manager coordinates and directs project activities, ensuring alignment with objectives.

Each stage is marked by specific gates for assessing progress and alignment. Best practices in communication, risk management, quality control, and resource allocation are applied throughout the project's lifecycle, with contracted milestones reported during regular Service Reviews.

In the discovery phase there are no risk related to regulatory changes or derogations required. In later phases if the project does explore connectivity between a ONO and IDNO there may be some regulatory issues to address.

Our approach to risk management is informed by our long established participation in Innovation Projects.

Risk Identification
Kelvatek continuously assess our projects for risk in the design and development phase as many risks can be mitigated by a change in approach that still fulfils the

original function and deliverable. These are maintained on a design and development project risk register

Risk Analysis
By analysing items on the risk register we can identify the scale of the risk and assign it for mitigation.

Risk Mitigation
Often the approach is to break the deliverables up into smaller manageable phases adopting an Agile approach this allows us to identify issues earlier in the development lifecycle

Risk Communication
Regular stakeholder meetings and transparent active lines of communication are maintained between Kelvatek and other stakeholders. These take the form of regular stakeholder updates where the potential impact of risks are assessed collectively to ensure risks are not overlooked and to ensure appropriate mitigation prioritisation

Supply interruptions There are no planned or potential supply interruptions to consumer supplies during installation or operation of GridLINK. During installation there are no interruptions when fitting Relink to a UDB. This can then establish a backfeed which can be used to keep the LV feeder powered during installation of the WEEZAP auto-reclosers at the substation feeder pillar fuse positions.

Interaction or engagement with energy consumers is not required for this solution since one of the the digital solution's and the supporting hardware's aims is to increase the hosted capacity allowing more LCT's to connect with minimal disruption

Key outputs and dissemination

By the end of the project discovery phase we want to produce the following series of reports:

- Report - Data use case definition - Kelvatek
- Report - Parameter perquisites and network topology assessment - Kelvatek
- Report - Digital Architecture - Kelvatek
- Report - Powerflow Analysis methodology -Kelvatek
- Report - Visualisation - Kelvatek

- Report - Cost Benefit Analysis - Kelvatek

We will disseminate learning from the project via the usual methods including dedicated webinars for the project as well as via the EIS.

GridLINK will not undermine the development of competitive markets by:

1. ensuring that the Digital Architecture for the project will adhere to the latest data governance and sharing principles set out by OFGEM, with a view to using accessible and open-standards.

2. Disseminating the above reports to the wider industry to detail the process and methodology utilised for each deliverables

Commercials

Intellectual Property Rights (IPR) (not scored)

We wish to reserve our position in relation to an alternative to the default IPR arrangements as provided for in Chapter 9 of the SIF Governance Document, to enable us to properly evaluate the background IP we will be bringing to the Project.

For the Discovery phase Kelvatek, has significant ability and the relevant expertise to deliver and are bringing significant background IP to the project. A series of functional specifications will be produced detailing the methodology and reasons for modelling and technology choice as well as the methodology around integration and deployment.

Value for money

The total Discovery Phase cost is £134,925. The total SIF funding request is £131,925

We are confident that using the technology solution provided by this project is both achievable and scalable. A similar placement optimisation method has been utilised in the Sentinel project and many of the power flow modelling methodologies, architectural designs and data pipeline methodology will utilise learnings taken from this project. The Decision Support System will be based off existing lessons learned from our PRE-Fault Decision Support System presented at CIRED in 2023. The hardware technology utilised is already at as high level of technological maturity with only potential alterations needed to ensure underground linkbox compatibility and with an above ground solution also available where this is not appropriate. The supply chain for the technology and the expertise already exists and is well established within Kelvatek.

in later phases the project will be moved into business as usual by mimicking previous Kelvatek and Northern Powergrid Innovation successes.

The project will in effect deliver a pilot implementation allowing us to assess functionality, performance, and impact on decision-making without fully committing to widespread adoption. This will allow both Kelvatek and Northern Powergrid to enact performance evaluation against the success criteria of later phases.

Feedback and iteration from discovery and alpha will allow us to fine tune both the models that power the project as well as establish BAU processes for operation and establish appropriate integration requirements.

As part of the project a full functional specification will be produced detailing the type of technology utilised, the integration methods, communication capabilities required, and any potential service provision needed to replicate this project across the GB network. User training and process adoption will be fully documented in later phases to allow the rapid deployment of the solution on any GB network and will be worked into Kelvatek's already large suite of standard operating procedures. Data governance and interoperability procedures will be fully documented including methodology for parameter input, data validation and data cleansing to ensure consistent data sets utilised by the DSS.

Supporting documents

File Upload

Gridlink close down Discovery presentation.pdf - 2.3 MB
GridLink Technology deployment assesment 1.0.pdf - 714.3 KB
GridLink Power-Flow Distribution Modelling Methodlogy 1.0.pdf - 357.2 KB
GridLink Network Schema Architecture Definition 1.0.pdf - 377.8 KB
GridLink Data visualisation study 1.0.pdf - 306.3 KB
GridLINK Northern Powergrid cost benefit analysis 1.0.pdf - 345.5 KB
GridLINK Northern Powergrid Topology Example 1.0.pdf - 1.8 MB
GridLINK Northern Powergrid Parameter Combination & Model Architecture 1.0.pdf - 323.8 KB
GridLINK Northern Powergrid Monitoring Prerequisites 1.0.pdf - 257.3 KB
GridLINK Northern Powergrid High Level Use Cases 1.0.pdf - 656.4 KB
Data pipeline study and automation requirements1.0.pdf - 431.7 KB
Data Cleansing Methodology 1.0.pdf - 215.6 KB
SIF Round 3 Project Registration 2024-05-15 10_27 - 57.7 KB

Documents uploaded where applicable?

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