SIF Discovery Round 2 Project Registration

Date of Submission

Jun 2023

Project Reference Number

10060423

Project Registration

Project Title

D-Suite

Project Reference Number

10060423

Project Licensee(s)

SP Energy Networks Distribution

Project Start

Apr 2023

Project Duration

2 Months

Nominated Project Contact(s)

a.moon@scottishpower.com

Project Budget

£157,114.00

Funding Mechanism

SIF Discovery - Round 2

SIF Funding

£131,875.00

Strategy Theme

Net zero and the energy system transition

Challenge Area

Improving energy system resilience and robustness

Lead Sector

Electricity Distribution

Other Related Sectors

Funding Licensees

SPEN - SP Distribution Plc

Lead Funding Licensee

SPEN - SP Manweb Plc

Collaborating Networks

UK Power Networks

Technology Areas

Active Network Management

Equality, Diversity And InclusionSurvey

Yes

Project Summary

Compared with conventional solutions, we will better address both thermal and voltage issues that we increasingly experience in LV networks. The TRL of this project is approximately 4-5, and will benefit from dedicated innovation support to uplift the readiness of the following technologies:

LV Distributed STATCOM (D-STATCOM). This technology has never been deployed in UK network;

Distributed Soft Open Point (D-SOP) -- We aim to build up on the technology developed by UKPN to trial a more flexible and controllable solution;

Distributed Smart Transformer (D-ST) -- We build up on learnings from LV Engine project to fit a partially rated power electronics within slim design distribution transformer; and

Distributed Harmonic Filter (D-HF) -- There are number of solutions in the market that need further development for LV applications.

In addition to those well-established ENA and IEC standards for network interfaces, insulation requirements etc. we will particularly ensure the compliance with safety requirements in power electronics specified in IEC 62477 and for monitoring equipment in BS EN 61010. IT and OT cyber security of the control system is also need adequately implemented based on those specified in IEC 62433, recommendations by ENA OT/IT taskforce and our updated ED2 internally developed cybersecurity requirements.

Project Description

The record numbers of electric vehicles, renewable energy sources and heat pumps being introduced to our energy system has created an opportunity for new technologies that have not been conventionally considered.

Following an assessment of the energy innovation landscape, it has become clear that there has been limited research on the LV focused power electronic technologies. This might be due to the perception of the cost and size of power electronic devices. Medium Voltage (33kV or 11kV) has been the typical limit where the business case can be easily found.

The new knowledge our proposal will bring includes:

1. Optimised design of several D-Suite power electronic devices suitable for LV deployment that are capable of operating in a coordinated control regime or a stand-alone control solution;
2. Detailed operational and public safety requirements, protection considerations and overall network interface requirement in the hardware design;
3. Coordinated control algorithm to maximise the existing network utilisation;
4. Holistic and systematic approach to identify the niche scenarios for a practical guidance for the future network planning and investment; and
5. First GB demonstration of a resilient D-Suite enabled LV network (SIF-Beta).

Project Description And Benefits

Applicants Location (not scored)

From our initial studies as part of the proposal preparation and the literature review, it is clear that we can realise the following benefits:

- Financial - future reductions in the cost of operating the network.
- Financial - cost savings per annum on energy bills for consumers.
- Financial - cost savings per annum for users of network services.

Project Short Description (not scored)

1. We will be able to use the existing assets and maximise their value by avoiding / deferring the reinforcement. Increased capacity to connect DER without reinforcement:
2. Based on the studies in Denmark [1], 5% to 40% more of PV generation can be integrated without triggering reinforcement. This can be estimated to be £10k per annum per feeder, providing additional income for our community[2]

Video description

https://www.youtube.com/watch?v=qYZNuAtW0Z4

Innovation justification

20kVA * 33% * 12hours *365days*£0.34/kwh= £10k per annum per feed, as the additional income for the community [based on electricity price: £0.34/kwh

Benefits Part 1

Financial - cost savings per annum for users of network services

Benefits Part 2

20kVA * 33% * 12hours *365days*£0.34/kwh= £10k per annum per feed, as the additional income for the community [based on electricity price: £0.34/kwh

Project Plans And Milestones

Project Plan and Milestones

WP1: Customer requirements and the future LV network core functions
Led by: Planning Department and SP Energy Networks Districts.
supported by: UKPN
Scope: To leverage the insights and professional analysis from the network owner, so that all the use cases can be identified.
Output and success Criteria: a list of key parameters required to identify the use cases such as: potential network topologies, connection criteria and demand/load growth forecast.

WP2: Literature review on the power electronic technology and supplier
engagements
Led by: Dr. Matt Deakin, RAEng Research Fellow, Newcastle University [University Consortium].
Scope: Leverage existing experience and finding from previous investment in the power electronic technology, to identify research gaps (opportunities) and inform technology development. This workpackage will interact with Workpackage 1 and fed-in Workpackage 3.
Output and success Criteria: Report of the landscape of PE devices suitable for
UK LV Networks, including a list of potential suppliers (supply chain engagement).

WP3: Initial Design of D-Suite, including H&S and Cyber considerations
Led by: Dr. Wenlong Ming, Integrated Energy, Cardiff University [University Consortium].
Supported by: UKPN
Scope: Carry out the initial design specifications based on the engineering, H&S and cyber considerations, such as corresponding standards including but not limited to:
Power quality standard EN50160, G55, Grid Code
This work package will also carry out initial market due diligence and provide the list of potential suppliers.
Output and success Criteria: Design specification of hardware and control Algorithm with reference to the industrial standards.

WP4: Commercialisation planning.
Led by: Innovation Team, SPEN.
Supported by: UKPN
Scope: working closely with project partners, leverage the networks at UKRI, identify the feasible route to market the project outcome and maximise the impact.
Output and success Criteria: road map of commercialisation, IPR policy

WP5: Project Management, Future Partnership, Knowledge Sharing and Next Phase.

Led by: Innovation Team, SPEN.
Supported by: UKPN
Output and success Criteria: a robust proposal for SIF-Alpha and its timely submission.

Regulatory Barriers (not scored)

No regulatory barriers have been identified. Both UKPN and SPEN's regulation teams will continue to monitor the situation and capture any possible regulatory barriers if they appear.

Commercials

Route To Market

Reducing the cost of Power Electronic Devices (PED) is a challenge the whole industry faces. By 2030, PED will cost half of their current price[1], incentivising their use as a method to reduce losses and encouraging Ball adoption. The wider deployment of power electronic devices in the distributed network will not undermine competitive markets, only increasing the supply chain competition by demonstrating the commercial potential at an international level, hopefully enhancing The UK's role.
Our initial market research through the Network Innovation Allowance[2] showed that while several companies claim that they have the technical capability to supply the D-suite for LV networks, there are no commercial products and few demonstrations of optimal design and operation. Currently, D-suite's technology readiness level (TRL) is approximately 4-5. This project aims to increase the Dsuite's TRL to 6-7 by the end of the Beta-Phase to experimentally prepare and test the D-suite in a real-world environment.

The proposal team aims to tackle the innovation commercialisation by technology push and end-user pull:

1. Technology Push, managed by The University Consortium, to optimise the design of hardware and control philosophy, taking onboard the latest engineering developments and operational needs from DNOs.
2. End-user Pull, managed by SPEN and supported by UKPN, to challenge the technology boundary with a clear purpose to improve its competitiveness and facilitate its application at LV. Network licensees, owners and operators will be the primary customer segment for this innovation, and they could own, operate, and purchase D-Suite type products following a successful beta phase delivery.

D-suite can be an attractive solution for DNOs because this project will provide:
A clear understanding about benefits (capital, operational, social, etc.) of LV power electronic solutions.
A set of criteria on which products can be best used.
Significant learning in terms of the optimum design and operation of LV power
electronics technologies.
A clear understanding about technical/commercial requirements for integrating existing LV AC assets with LV power electronics solutions.

As early adopters of the D-suite, we will continue to carry out extensive market research and due diligence to identify capable suppliers at international level. This will stimulate competition in the supply chain, attract more private investment and support innovators to cross the chasm between early adoption and an early majority which will consequently **reduce the cost and risk from adopting LV power electronics technology.**

Intellectual property rights (not scored)

The proposal will comply with the default SIF governance regarding IPR. i.e., any relevant foreground IPR will be owned and shared by electricity licensees.

Costs and value for money

See benefits.

Document Upload

Documents Uploaded Where Applicable

Yes

Documents:

D-Suite application.pdf

This project has been approved by a senior member of staff

☑ Yes