Electricity Network Innovation Competition
Screening Submission Pro-forma

Notes on completion

Before completing this form, please refer to the Electricity Network Innovation Competition (NIC) Governance Document.
Please use the default font (Verdana size 10) in your submission, the text entry areas are predetermined and should not be changed. The full-completed submission should not exceed 10 pages in total.
Ofgem will publish all the information contained within the Screening Submission.

Funding Licensee

London Power Networks plc (LPN)

Network Licence Project Partners

SP Distribution plc and SP Manweb plc (SPEN in this document)

Funding Licensee area

LPN

Project title

Active Response to Distribution Network Constraints (Active Response)

Project Summary

The Licensee must provide an approximate Project start and end date.

Emerging low carbon technologies (LCTs) such as electric vehicles and heat pumps will significantly increase demand on distribution networks, requiring reinforcement in late RIIO-ED1 and throughout ED2. Electrifying the Greater London bus and taxi fleets alone could increase peak demand on our London network by over 50%.
Active Response will reduce the need for this reinforcement by building on previous work in the fields of advanced automation and power electronics to remove constraints to network meshing and release capacity. Combining power electronics with an advanced automation and optimisation system will enable network meshing, which if rolled out nationally has the potential to deliver £2.6bn savings over RIIO-ED1 and ED2.
We propose to develop power electronic devices at LV and HV to Technology Readiness Level (TRL) 8, building on the Soft Open Points (SOPs) developed to TRL 6 by UK Power Networks' Flexible Urban Networks-LV (FUN-LV) project. These can enable network meshing where it is not possible for many reasons including voltage difference, uneven load sharing or fault level. These will be controlled on the network to allow us to test the interaction between SOPs and compare the benefits of different meshing techniques.
SPEN is taking on a Design Authority role for this project to ensure that other DNOs can adopt the technology, maximising the benefits to customers. The project will run for approximately four years from January 2018 to November 2021.

Estimated Project funding

The Licensee must provide an approximate figure of the total cost of the project and the NIC funding it is applying for.

Total cost of Project	£15.3m	**NIC funding requested**	£12.1m
Cross Sector Projects only: requested funding from Gas NIC, NIA or second tier LCN Fund?	*If yes, please specify* n/a		

Problem

The Licensee must provide a narrative which explains the Problem(s) which the Project is seeking to address.

UK Power Networks (UKPN) is seeing an increase in the uptake of LCTs. Nationally, ultra low-emission vehicle (ULEV) registrations have increased by 47% since 2015 and by 118% since 2014. This means that there are currently more than 16,600 electric vehicles (EVs) registered across our three licence areas, following a trend close to the "Gone Green" scenario. However, the uptake of heat pumps is lower than previously forecast.

There has also been growth in local generation such as Combined Heat and Power (CHP) plant, largely driven by the Mayor of London's target to generate 25% of London's heat and power requirements locally by 2025.

In addition, Transport For London (TfL) is setting policy and targets to reduce vehicle emissions and improve air quality. This includes making taxis and private hire vehicles low emission capable, which corresponds to all new vehicles from 2018 and an entire 88,000 fleet by 2033. We estimate that electrifying the Greater London bus and taxi fleets could result in an increase of up to 2.8GW of new load on our London network by 2033 – more than half of the existing peak demand. We estimate that up to £331m of additional reinforcement would be required in RIIO-ED1 and ED2 under these circumstances, of which more than 66% would be attributable to HV reinforcement.

We expect that other local authorities will follow London's lead to meet the Carbon Plan targets in their areas. To avoid a significant increase in infrastructure costs, DNOs require a toolbox of smart technical and commercial solutions to manage the increase in demand in the most efficient and effective way. The implementation of these smart solutions will make the distribution networks more complex, both to plan and to operate, requiring overarching systems and policies that enable visibility and allow safe operation.

Within the smart toolbox, technical solutions include Powerful-CB to alleviate fault level constraints at main substations; commercial solutions include flexibility arrangements with customers to provide demand or generation response services such as those enabled in the TDI 2.0 project. These solutions do not yet cover all situations, leaving room for additional smart solutions. Active Response proposes to add additional functionality to this toolbox, ensuring that the lights are kept on at the least cost to customers.

Method(s)

The Licensee must describe the Method(s) which are being demonstrated or developed. It must also outline how the Method(s) could solve the Problem. The type of Method should be identified where possible eg technical, commercial etc.

Active Response proposes to develop and trial advanced automation and power electronics to release distribution network capacity at minimum cost, equipping DNOs with suitable tools to deploy proactively as a response to the challenges presented by the uptake of LCTs.

Network meshing (connecting circuits together to share load) is a well-understood method of releasing capacity to overcome constraints on the distribution network. However, in many locations it is not possible to apply this method due to network complexity, voltage difference, uneven load sharing, phase shifts, circulating current, or fault level.

Power electronic devices are a key enabling technology that allows meshing of networks where it is otherwise not possible by direct connections. Active Response proposes to develop Soft Open Points (SOPs) at HV and LV to TRL 8 and operate these as part of an automated, meshed network.

Method(s) continued

We are looking to build on the award winning FUN – LV project, which developed SOP technology from TRL 4 to TRL 6 at LV.
Active Response will also develop an advanced automation and optimisation system, with the ability to change network configuration and control DNO and third party owned flexible devices. Elements of this system will build on learning from existing projects as discussed on page 6 under "How is the project innovative". This will allow us and other DNOs to optimise the operation of our networks measured by efficiency, cost, losses, customers at risk, or other parameters under normal conditions; and maximise supply restoration under post-fault conditions.
We intend to trial these technical solutions in two areas with different network architectures. Along with the SOPs, these areas will include measurement and remote control devices with HV remote control, LV circuit breakers (CBs) and link box switches. This will enable us to trial the interaction between the power electronic equipment and prove the benefits of the advanced automation and optimisation system.
The purpose is to prove that the SOP technology interacts positively with traditional and automated meshing techniques to release capacity at minimum cost, overcoming constraints more quickly and avoiding traditional reinforcement investment.

Funding commentary

The Licensee must provide a commentary on the accuracy of its funding estimate. If the Project has phases, the Licensee must identify the approximate cost of each phase. OFTOs should indicate potential bid costs expenses.

UKPN's costs are based on approximated work volumes required for the potential trial areas and unit costs for tasks where they exist. These costs are combined with estimates based on experience gained from similar projects and quotations from potential suppliers where available.
We are making a contribution of £3.2m, in excess of the 10% compulsory contribution, because we believe in the benefits Active Response could bring if successful. This will fund several enabling elements of the project including the installation of LV circuit breakers and some network preparatory works. It also includes costs required to develop a connected LV network model for the trial areas in our Network Management System, a requirement for the advanced automation and optimisation system.
Where a supplier partner looks to gain significant competitive advantage from their involvement in the project, an in kind contribution to project costs will be sought.

Specific Requirements (please tick which of the specific requirements this project fulfils)

A specific piece of new (ie unproven in GB) equipment (including control and/or communications systems and/or software)	✔
A specific novel arrangement or application of existing electricity transmission equipment (including control and communications systems software)	
A specific novel operational practice directly related to the operation of the electricity transmission system	
A specific novel commercial arrangement	

Accelerates the development of a low carbon energy sector & has the potential to deliver net financial benefits to existing and/or future customers

The Licensee must demonstrate that the Solution has the potential to accelerate the development of the low carbon energy sector in GB and/or deliver wider environmental benefits to GB customers. The Licensee must demonstrate the potential to deliver net financial benefits to existing and/or future customers.

Active Response contributes to the Carbon Plan by preparing the networks to facilitate secure, sustainable low carbon energy and enabling low carbon transport. The adoption of low carbon energy and transport could be restricted by network constraints, making connection costs for generation and charging points prohibitive. UKPN aims to reduce the cost of connecting these LCTs by developing innovative solutions to the challenges and network constraints that they present.

The uncertainty surrounding the volume and demand profile of some LCTs means DNOs need short-term solutions that can address constraints quickly while longer-term solutions can be implemented. If networks with local demand and generation can be meshed together then there is further scope to avoid upstream reinforcement.

Active Response will empower control engineers to configure the network in the most efficient way for different demand/generation conditions. Where spans of the network are separated by normally open points, clusters of EV charge points or distributed generation (DG) can cause localised constraints. Meshing networks using SOPs or other means can alleviate these constraints and have the potential to deliver £2.6bn of savings across GB over RIIO-ED1 and ED2, according to the Smart Grid Forum Workstream 3. The advanced automation and optimisation control capability can locally offset demand with DG generation, improving efficiency and releasing capacity.

The Active Response methods will in most cases be faster, cheaper and more sustainable than traditional solutions; the tools will also introduce new methods for network management, supporting the emerging requirements of a Distributed System Operator (DSO) commercial model. Where interconnecting networks would otherwise require expensive unit protection installation or cause excessive circulating currents, SOPs will reduce costs for network upgrades and connections. SOPs can also provide reactive power support to assist with voltage control; further enabling low carbon generation to connect to the distribution network and remain connected where possible in abnormal network running arrangements.

The SOPs can be deployed strategically to defer network reinforcement. If or when they are no longer required they can then be redeployed to a new location. This is a more sustainable approach, particularly as an enabler for network connections otherwise awaiting long-term network reinforcement. It could address uncertainty and connection risk in large LCT projects.

Network meshing is an attractive alternative to HV reinforcement, both in the short and long term. Based on current estimates, an HV SOP installation will provide a net financial benefit if it can defer the average LPN primary reinforcement by three years, extending to 13 years for average reinforcement in our Eastern and South Eastern Power Networks (EPN and SPN). This could present savings to the DNO and its connected customers as a result of deferred reinforcement or enable a point of connection for a new customer significantly sooner than would be possible via traditional means.

Suppliers have indicated a reduction in cost of up to 50% for the LV SOP from the prices used in the FUN-LV project due to technology improvements. Additionally, as HV SOPs are an innovative new technology, the cost is expected to decrease further following a shallow reduction curve. Volume purchasing will also bring costs down in a UKPN or GB-scale rollout.

Delivers value for money for electricity customers

The Licensee must demonstrate that the Method(s) being trialled can derive benefits and resulting learning that can be attributed to or are applicable to the electricity transmission system.

The Active Response methods will be trialled at the minimum scale (and cost) necessary to ensure a statistically robust demonstration of network meshing functionality. The two trial areas are expected to include fewer than 200 distribution substations, less than 0.25% of UKPN's network.

UKPN will employ a robust governance process with supply partners to ensure that the cost of the project remains competitive. To ensure value for money, UKPN staff or framework contractors will carry out the installation and site work.

We will build on learning and best practice from current and previous innovation projects from all DNOs to avoid any unnecessary duplication. We are also partnering with another DNO on this project to accelerate the adoption of products and delivery of benefits. These points are discussed further below.

The benefits of this project are expected to accrue to customers directly (by providing quicker and more efficient connections for LCTs) and indirectly (by deferring/reducing Licensees' expenditure on load-related reinforcement). The total project cost is significantly smaller than the potential benefits it may help enable across GB.

Demonstrates the Project generates knowledge that can be shared amongst all Network Licensees

The Licensee must explain the learning which it expects the Method(s) it is trialling to deliver. The Licensee must demonstrate that it has a robust methodology in place to capture the learning from the Trial(s).

Active Response aims to develop and trial advanced automation and power electronics to release distribution network capacity at HV and LV. This includes validating how multiple power electronic devices interact with each other and with other smart solutions, and how their control can be incorporated into an optimised, meshed network.

Following detailed collaboration sessions between UKPN and SPEN, SPEN has agreed to take an active role in the project as a Design Authority. This role will include approving the designs and technology developed within the project for use on its network (pending appropriate labelling, locking and other arrangements to suit local conventions). This will ensure that SPEN and other Licensees can easily adopt Active Response directly into business as usual.

Building on our success in delivering and disseminating innovation project learning, the project's results will be captured and disseminated using best-practice methods available amongst the LCNF/NIC community.

Please tick if the project conforms to the default IPR arrangements set out in the NIC Governance Document? ✔

If the Licensee wishes to deviate from the default requirement for IPR then it must demonstrate how the learning will be disseminated to other Licensees and how value for money will be ensured. The Licensee must also outline the proposed alternative arrangements and justify why the arrangements are more suitable than the default arrangements.

Project partners have confirmed that they are able to work within the default IPR arrangements.
We are aware of the IPR issues that may arise if a project partner is unable to, or decides not to make their Relevant Foreground IPR available as part of a commercial product. In principle we would seek a similar approach as for Powerful-CB (refer bit.ly/powerful-cb-fsp, section 5.3). We will provide full details of our proposed IPR arrangements in the Full Submission.

How is the project innovative and with an unproven business case where the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness?

Demonstrate why the Licensee has not previously used this Solution (including where the Solution involves commercial arrangements) and why NIC funding is required to undertake it. This must include why the Licensee would not run the trial as part of its normal course of business and why the Solution is not Research.

Active Response will build on the findings from previous projects including:
• LV SOP technology developed to TRL 6 in the award-winning FUN-LV project;
• Flexible Medium Voltage DC link trials in the SPEN Angle-DC project;
• the Flexible Power Link (FPL) method from Western Power Distribution's (WPD) Network Equilibrium project;
• the optimisation system trials in Electricity North West Limited's (ENWL) Smart Street project; and
• automation from SPEN's Flexible Networks for a Low Carbon Future (FlexNet) project.

Notably FUN-LV identified physical size, audible noise and efficiency (heat dissipation) as barriers to adoption of SOPs in residential areas. It is now possible to overcome these barriers due to recent innovations in semiconductor technology, however this presents significant additional design risk that will require further operational trials. As such we would not be able to justify taking this risk on a business-as-usual (BAU) project. Operational safety and voltage transients were issues identified that restricted the automated switching of HV CBs to reconfigure networks within Smart Street and FlexNet. We believe that the risks involved in overcoming these issues are greater than would be acceptable for a BAU project, but that there are sufficient benefits to justify rollout if a trial is successful.

Project Partners and external resourcing / funding

The Licensee must provide evidence of how Project Partners have been identified and selected, including details of the process that has been followed and the rationale for selecting participants and ideas for the project.

The Licensee should provide details of any Project Partners who will be actively involved in the Project and are prepared to devote time, resources and/or funding to the Project. If the Licensee has not identified any specific Project Partners, it should provide details of the type of Project Partners it wishes to attract to the Project.

In preparation for the NIC, UKPN consulted internally and externally, drawing up a shortlist of eight proposals. This included innovative proposals submitted through the Energy Innovation Centre (EIC) and Power Networks Demonstration Centre (PNDC). These were reviewed against NIC eligibility, technical feasibility and relevance to challenges in RIIO-ED1, aligned to UKPN's Innovation Strategy.

From this shortlist, Active Response was chosen as it addressed a gap in our smart solutions toolbox, building on existing innovation to address network constraints to the uptake of LCTs. To define the scope of the project and confirm the most adequate partners we have worked closely with the parties mentioned below:

Turbo Power Systems (TPS) responded to a "call for innovation" through the EIC with an innovative product proposal. We were impressed by their proposal and track record of successfully developing innovative power electronic systems. We conducted further discussions with them on the feasibility of developing a different new product to meet the requirements of this project.

The Energy Practice of Ricardo Energy & Environment has a long and successful track record in delivering innovation projects in the UK power sector. They have a solid understanding of network architectures and a particularly detailed knowledge of the role of power electronics within power networks, non-invasive monitoring systems, communication requirements and effective installation/commissioning procedures. We are confident that Ricardo will bring the necessary skills and expertise to this project.

UKPN is currently in discussions with a potential provider for the advanced automation and optimisation system. If these discussions are not successful, we intend to use our existing BAU procurement processes to avoid interface issues and duplication within our IT estate. In either case, we will undertake a detailed technical and commercial review to ensure that the partner has the necessary skills and experience, and provides value for money.

We will be carrying out a procurement exercise to select one or more academic partner (s) with experience in the control, design, modelling and application of power electronic devices in the distribution network.

In order to deliver other elements of the project such as installing controllable devices and developing the required user tools for this project, UKPN will work with existing framework suppliers and contractors. Where no existing supply chain exists, a competitive tender process will be followed to ensure best value for money.

As described above, UKPN will collaborate with SPEN to maximise the value and minimise the cost of transferring the outputs from Active Response to business as usual within SPEN and other Licensees.

Derogations or exemptions

The Licensee should outline if it considers that the Project will require any derogations, exemptions or changes to the regulatory arrangements.

At this early stage of the project, we are not aware of any issues that might require any derogations, exemptions or changes to regulatory arrangements.

Customer impact

The Licensee should outline any planned interaction with customers or customers' premises as part of the Project, and any other direct customer impact (such as amended contractual or charging arrangements, or supply interruptions).

The focus of this project will be on smarter operation of the existing network assets and we do not envisage that there will be any regular interaction with end customers. Since the detail design and trial locations for the equipment to be installed as part of this project are yet to be selected, there is a possibility that a method statement will require planned outages during the installation of some of the equipment. This will be delivered via normal operational procedures and in such a way as to minimise any disruption to affected customers.

Details of cross sector aspects
The Licensee should complete this box only if this Project forms part of a larger cross sector Project that is seeking funding from multiple competitions (Electricity NIC, Gas NIC or LCN Fund). The Licensee must explain about the Project it will be collaborating with, how it all fits together, and must also add a justification for the funding split.
N/A

Any further detail the Licensee feels may support its submission
Our Innovation Strategy states that, as part of the development of proposals for network innovation projects, we include risk assessment and identification of mitigating provisions. Our governance framework for innovation projects also ensures that we continuously assess and monitor our innovation work with respect to health and safety, thus ensuring that such risks are actively assessed and addressed in a manner commensurate with our commitment to health, safety and sustainability. By partnering with SPEN on Active Response we are ensuring best value for customers from the network innovation funding. This will enable faster knowledge gain and incorporation in another DNO's BAU practice to deliver benefits if the project is successful. Collaboration with other DNOs is key to increasing the pace of innovation and benefits accrued to customers. We would also like to give our thanks to members of ENWL, Northern Powergrid, SPEN, Scottish and Southern Electricity Networks (SSEN) and WPD, who have shared the learning they have generated from projects in this arena that has provided an input to the scope of this project.
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