

Low Carbon Networks Fund Screening Submission Pro-forma

Notes on completion			
<p>Before completing this form, please refer to the LCN Fund Governance Document, which details in full the information that you are required to provide. 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 <u>10 pages</u> in total.</p> <p>Ofgem will publish all the information contained within the Screening submission.</p>			
DNO Group			
UK Power Networks			
Participant DNOs			
DNO area(s)			
South Eastern Power Networks plc			
Project title			
Kent Active System Management (KASM)			
Project summary			
<i>The DNO must provide an approximate Project start and end date.</i>			
<p>The network serving east Kent already accommodates significant intermittent generation from onshore and offshore wind farms and several photovoltaic (PV) generators. Additional intermittent generation is planned in this area and may result in rapidly changing power flows not previously experienced on this network. UK Power Networks is, therefore, keen to improve network capacity, network visibility and contingency analysis (CA) capabilities.</p> <p>Performing CA within operational timeframes is new in a GB DNO and will enable us to;</p> <ul style="list-style-type: none"> • Enhance the interaction between planning (typically months) and operational timeframes (typically days), • Improve congestion management in response to outputs from different generator types at varying locations and times, • Maximise availability of short term capacity, and • Determine pre-emptive network actions to mitigate constraints. <p>Benefits from the CA tool include the ability to operate the network closer to operational limits. The project will also trial the installation of 'Smart Wire' technology to manage 132kV circuit power flows in response to suggested CA pre-emptive actions and/or to create additional permanent capacity.</p> <p>The project will commence in January 2015 and is anticipated to complete in the fourth quarter of 2017.</p>			
Estimated Project funding			
<i>The DNO must provide an approximate figure of the total cost of the Project and the LCN Funding it is applying for.</i>			
Total cost of Project	£3.9m	LCN Funding requested	£2.9m
Cross Sector Projects: Requested funding from Electricity NIC, Gas NIC or NIA?	<p>If yes, please specify</p> <p>NO.</p>		

Problem

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

Our operating area of east Kent currently contains approximately 510MW of largely intermittent wind and PV generation connected to the 132kV, EHV and HV networks. Connection agreements for significant (>100MW) further PV and wind generation have been accepted and they are due to connect in the short term.

Whilst the network has some benefits of interconnection these can be constrained by mis-matches in circuit lengths and particular tee-off arrangements.

Managing power flows on the complex, interconnected distribution network in this area will become increasingly challenging as additional intermittent generation materialises. Generation output across the network will vary considerably by type, location and prevailing weather patterns resulting in rapidly changing power flows, with the potential of reverse power flows to exceed circuit capacity on the 132kV network.

As the interaction between intermittent DG and the distribution network amplifies, UK Power Networks will introduce new operational planning and management tools to ensure secure network operations and renewable generator access can be optimised. We will establish CA functionality in outage planning and the control centre that is designed to operate within an operational timeframe of days, rather than a planning contingency timeframe of months.

We are also aware of transmission network concerns in east Kent and will pursue any synergies between our LCNF project objectives and National Grid interests.

Method(s)

The DNO must describe the Method(s) which are being trialled. The DNO must outline how the Method(s) could solve the Problem. The type of Method should be identified where possible e.g. technical, commercial etc.

The variable power flows on the network in East Kent, driven by intermittent renewables, interconnector power flows and a highly meshed and interconnected topology require to be managed in operational timescales. We propose to trial two methods; (i) a new operational practice known in the transmission sector as Contingency Analysis; and (ii) a new flexible power diversion technology branded as "Smart Wire".

Contingency Analysis (CA)

CA provides more effective management of the network with additional insight to changing conditions applicable within operational timescales. Changing network conditions can be caused by new generation connection patterns, changing weather patterns, interconnection power flows and/or credible fault scenarios. Under these scenarios, the CA tool will automatically quantify operating shortfalls. This in turn can help network operators to avoid undesirable conditions by taking pre-emptive actions. In addition to helping to manage variable power flows and ensuring the operational integrity of an increasingly interconnected network, other benefits include;

Method(s) continued

- **Prioritisation of Actions** - Actions that are applicable in most scenarios can be identified, captured and ranked by importance, potentially simplifying operational processes;
- **Integration of planning horizons** - Operational staff have the opportunity to undertake a quick 'what if' analysis in response to changing network conditions, rather than wait for a long-term planner to re-programme a model. This better integrates operational and strategic network planning.
- **Valuation of flexible, scalable and re-locatable technologies** - pre-emptive actions may include the utilisation of new, less expensive and flexible technologies in order to manage power flows in some scenarios. We propose to trial one such technology called "Smart Wire".
- **Operating closer to operational limits** - Effective constraint management in order to release short-term network capacity will allow the complex east Kent network to perform closer to its operating limits.

Smart Wire trial as an operational solution - In the United States, early trials have begun on a novel technology branded as "Smart Wire" and which is an example of 'distributed series reactance' (DSR). The units are mounted on the phase conductors of a line and act as a 'throttle', optimising the balance of power flows down less well utilised circuits and maximising capacity. They also report real-time data on power flows, conductor temperature and 'sag' angle which enables dynamic line ratings; a potential pre-emptive action that could alleviate network stress. The units are also capable of measuring power harmonics yielding more information on their magnitude and behaviour. This scalable, retro-fit solution distributed along a line, contrasts with other discrete solutions available, such as quadrature boosters.

Funding commentary

The DNO is to provide a commentary on the accuracy of its funding estimate. If the Project has phases, the DNO must identify the approximate cost of each phase.

We have based our estimate of £2.2m for the Smart Wire technology and CA software on budget estimates received from vendors. These estimates are based on initial network scaling criteria for east Kent (e.g. number of nodes, circuits, transformers, grid infeeds) and a broad assessment of the number of 'Smart Wire' units. Future detailed design studies may require our initial assessment to be modified and it is anticipated any impact on cost will be contained within the project contingency. We have added an estimate for project management of £0.9m based on experience of existing Tier 2 projects. Finally, a contingency allowance of £0.8m is included at this stage to cover the uncertainties discussed above. Total anticipated project costs are £3.9m.

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

A specific piece of new (i.e. unproven in GB) equipment (including control and communications systems and software) that has a Direct Impact on the Distribution System)	✓
A specific novel arrangement or application of existing Distribution System equipment (including control and communications systems software)	
A specific novel operational practice directly related to the operation of the Distribution 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 DNO must demonstrate that the Solution makes a contribution to the Carbon Plan and has the potential to deliver financial benefits.

In line with requirements of the LCN Fund Governance Document, the DNO should provide the following to demonstrate compliance with this criterion:

- i. *How the proposed Project will make a contribution to the Carbon Plan. In particular the DNO should outline:*
 - *The aspect(s) of the Carbon Plan which the Solution(s) facilitates.*
 - *The contribution the roll out of the Method(s) across GB can play in facilitating these aspects of the Carbon Plan.*
 - *How the roll out of the Method(s) across GB will deliver the Solution(s) more quickly than the most efficient method currently in use on the GB Distribution System.*
- ii. *The financial benefits of the Method(s) being trialled. Financial benefits should be calculated as set out in Section Two, paragraph 2.13, of the LCN Fund Governance Document.*

The Carbon Plan describes the Government's strategy to maintain security of supply whilst tackling climate change in a way that minimises costs and maximises economic benefit. This project strongly supports the principles that underpin this strategy.

Facilitate Low Carbon Generation - Within the east Kent area, high solar irradiance and favourable wind conditions support a timeline of renewables projects which contribute to the Carbon Plan's low carbon generation objective. The combination of the CA platform and the Smart Wire technology will give us deeper insight into the behaviour of this part of the network and provide more flexible options to manage it. Ultimately, this improved capability could be reflected in a greater range of options to expedite future project developments within a geography that is attractive for renewables projects. For example, improved access could be provided to non-firm generation connections. A wider implementation of this technology across GB might be expected to lower project developers' barriers to entry.

Building a stronger and smarter grid - We expect that power flows will become increasingly unpredictable, both intra and inter day, particularly in areas such as east Kent. This is due to (i) new intermittent sources of generation such as wind and solar; (ii) inherently variable loads such as electric heating and electric vehicles and (iii) increasing interconnection *within* distribution networks and *between* distribution and transmission networks. The Carbon Plan implicitly recognises the complexity of power flows and calls for stronger and smarter grids to accommodate them.

The CA platform is a key enabler of smarter networks. It provides insight into alternative network configurations and provides opportunities for new technologies such as the Smart Wire technology being trialled in this project. Ultimately, the CA tool will allow the network to operate closer to its design parameters whilst maintaining the integrity of the power system. Were this to be adopted across other (increasingly interconnected) distribution networks, we might see a wider and more rapid adoption of smarter alternatives to traditional network investment.

Minimising cost and maximising economic benefit - As the Carbon Plan describes, all renewables generation projects are assessed against wider environmental factors before consent is granted. This inevitably drives uncertainty into the project lifecycle and timing of new generation connections. Our Method works towards a solution which maximises the volume of generation that can be connected to the network and minimises recourse to incremental investment until the investment signals are clear. By postponing traditional investment, and highlighting opportunities for alternatives, this project contributes towards reducing the cost of meeting the Carbon Plan.

We will complete a robust cost benefit analysis in due course. However, we believe that in response to the network issues in east Kent the current 'business as usual' practice would require further capital investment. Early thinking would put the cost of this range of options in the low millions of pounds. This is comparable with the cost of learning from CA deployment in the network serving east Kent. However, the techniques will be relevant to our other operating areas and other DNOs' networks. Consequently we expect the benefits of the CA platform to scale with a wider implementation.

Has a Direct Impact on the operation of the distribution network

A Second Tier Project must demonstrate that the Method(s) being trialled will have a Direct Impact (as defined in the Governance Document) on the operation of a DNO's Distribution System.

In the case of CA, the Direct Impact will take the form of revisions to switching instructions prepared in advance for fault events or planned outages, or pre-emptive changes to network configuration and settings. In the event of network faults, these have a Direct Impact on the power flows on the network post-fault.

In the case of the Smart Wire technology, the Direct Impact will be seen as a tangible difference to the power flows on the overhead line.

Generate knowledge that can be shared amongst all network operators

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

In line with the LCN Fund Governance Document, the DNO should provide the following to demonstrate compliance with this criterion:

- i. How the Method(s) being trialled will generate new knowledge.*
- ii. What methodology will be used to capture results from the trial and disseminate that learning to all DNOs.*

CA platform

We will learn from and comprehensively report on the implementation of the CA platform. Specifically;

- **Procurement through to implementation** - Subject to procurement confidentiality, we will capture the learning from all stages of the implementation lifecycle from specification to development and control system integration to aid the deployment of the technology into another DNOs, and
- **Operation and Impact** - The operation of the system once installed will provide the major opportunity for learning. Operating procedures will be changed to incorporate the use of the CA platform, which will enable the formal reporting of how frequently and effectively it is utilised. In addition, we will include any 'softer' learning associated with how frequently and effectively the package is used by staff from both the operational and outage planning team.

Smart Wire Technology

The Smart Wire technology will be incorporated as an 'object' in DNO power system models, in order that the effect of a network of these devices can be fully understood. We will report on all learnings associated with this, including any adjustments to the definition of the objects' default values, and how outturn power flows compare with the forecast values against different network configurations. Other DNOs will benefit from a comprehensive instruction manual, pertinent to typical GB networks at the 132kV and potentially lower voltage levels. This will enable other DNOs to rapidly assess the suitability of the technology for their particular purpose before considering moving to the procurement phase. We will also develop and communicate best practice field implementation learning.

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



If the DNO wishes to deviate from the default requirement for IPR then it must demonstrate how the learning will be disseminated to other DNOs taking into account any potential constraints or costs caused by or resulting from the proposed IPR arrangements.

Focus on Methods that are at the trialling stage

The DNO must demonstrate that the proposed Project would not be performed in the DNO's normal course of business.

In line with the LCN Fund governance document, DNOs should provide the following to demonstrate compliance with this criterion:

- i. How the Method(s) being trialled are untested at scale and circumstance in which the DNO wishes it to be deployed.*
- ii. Why the scale of the Project is required to deliver the learning and why the Project would not have been an appropriate First Tier Project.*
- iii. Why it has not previously used this Method to solve the Problem (including where the Method involves commercial arrangements) and why LCN Funding is required to undertake it. This must include why it would not run the trial as part of its normal course of business and why the Solution is not R&D.*

Untested in GB at an appropriate scale – CA platforms are previously untested on GB distribution networks as DNO network management has not been sufficiently complex to warrant it. However, in the east Kent area, both current and forecast network interconnectivity and operational complexity now support such a trial. The trial is appropriately sized to provide meaningful results whilst limiting the scale to the manageable area of east Kent.

Appropriate for Tier 2 funding - We are conscious that the project is of a size that lies on the boundary between Tier 1 and Tier 2 funding requirements. However, the duration would prevent it from completing within the Tier 1 funding mechanism timeframe and NIA allowances will only be fully finalised following a public consultation in July. Therefore, we are keen to pursue this proposal under LCNF Tier 2 funding and will keep this under review with Ofgem.

Rationale for LCNF funding – The Smart Wire technology has passed through the R&D phase and is now being implemented in two trials in the US. This will be the first trial within a GB network, and so would not currently be an appropriate business as usual investment. Similarly, whilst the CA platform is a mature transmission technology, we could not procure an off the shelf system without the extensive development and trialling enabled under LCNF.

Meets LCNF requirements– This projects meets two of the Tier 2 requirements set out in paragraph 2.8 of the Governance document and all the criteria in paragraphs 2.9 to 2.24. Both the CA platform and the Smart Wire technology are unproven technologies in GB DNOs. This project would be the first to trial both technologies and to understand how the Smart Wire system can both inform the CA analysis and act as a solution to managing the network. Consequently, the control strategies that arise from using CA analysis would be novel operational practice.

Project Partners and external resourcing/funding

The DNO 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 DNO 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 DNO has not identified any specific Project Partners, it should provide details of the type of Project Partners it wishes to attract to the Project.

This project plans to implement the first step to active system management through the integration of contingency analysis in the distribution control centre environment, a first in GB. It is anticipated that several vendors of contingency analysis packages will be keen to participate as a partner in such a development to advance their distribution network management capability. A solution will be sought by open tender from appropriate vendors.

We will seek a partnership with the successful CA vendor to share the risk in developing and migrating this platform into the distribution operational environment. Commercial arrangements will be established for the full submission in July.

The use of 'Smart Wire' technology is unique in GB and negotiations with the local agent will encourage a partnership approach with UK Power Networks as an early adopter.

Background to the selection of the idea

We developed a list of 11 project concepts; and separately became aware of two requests for partners within Network Innovation Competition (NIC) projects. The list of 11 ideas comprised of 4 brought forward from within the UK Power Networks business, and 7 from external partners including 3 SMEs. These were evaluated and three lead concepts developed further in the weeks leading up to the ISP submission (again, led by 1 SME, 1 major vendor and the internal business respectively), before final selection of this preferred proposal.

The rationale employed in selecting the shortlist incorporated judgement on several aspects with consensus agreement attained during a selection workshop. For instance, it was important that the proposal;

- addresses a substantial challenge that the business is already going to face,
- is clearly articulated,
- provides a sufficiently novel solution beyond business as usual,
- adds breadth to our project portfolio without duplication,
- is cost-effective when compared to traditional network options, and
- demonstrates clear benefits to distribution customers.

Derogations or exemptions

The DNO should outline if they consider that the Project will require any derogations, exemptions or changes to the regulatory arrangements.

We do not foresee at this stage any derogations or changes to the regulatory regime to support these trials.

Customer impact

The DNO 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).

We do not envisage any direct customer impacts resulting from the deployment of the CA software and Smart Wire technologies.

Any necessary network outages or liaison with customers during the implementation of these methods will be managed in accordance with our standard business practices to ensure continuity of supplies to our customers.

In the event that CA implementation manifests new options for pre-emptive or corrective actions to address network constraints we will use these to better inform the longer term planning analysis. We will then engage with customers to explore any new options using best practices developed through experience with our other LNCF Second Tier projects (FPP, LCL) and our business teams that work specifically with this market segment.

The focus will be on providing clear and robust upfront information to any affected customers and participation in the trial will be voluntary.

Details of cross sector aspects

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

Any further information the DNO feels may add to the submission

We are aware of, and are a partner to, National Grid’s submission to the Network Innovation Competition which is investigating transmission network issues in the same geographic area of east Kent.

The two projects are separate and distinct, but there are learning synergies between the two projects. Both parties are focussing on their respective challenges; transmission (frequency and voltage stability) through the NIC proposal led by National Grid and distribution (optimising capacity and connected generation) through the LCNF proposal led by UK Power Networks.

These clearly provide an opportunity to understand in detail the holistic challenges and interactions created by embedded and offshore generation to both distribution and transmission network operators.

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