

Electricity Network Innovation Competition Screening Submission Pro-forma

Notes on completion			
<p>Before completing this form, please refer to the Electricity Network Innovation Competition (NIC) Governance Document, which details all of 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>11 pages</u> in total.</p> <p>Ofgem will publish all the information contained within the Screening Submission.</p>			
Funding Licensee			
National Grid Electricity Transmission Plc			
Network Licence Project Partners			
Funding Licensee area			
National Grid Electricity Transmission Plc			
Project title			
South East Smart Grid (SESG)			
Project Summary			
<i>The Licensee must provide an approximate Project start and end date.</i>			
<p>The transmission system in the South East is the optimal location for additional interconnectors to Europe and a potential location for significant volumes of renewables such as wind and solar power. Recent reports have indicated that an additional 4GW of interconnector capacity could reduce the GB wholesale price by circa £1bn per annum. The increase in the connection of renewables in this area will also reduce carbon emissions in excess of 1.5 million tonnes of CO₂ per year (based on just 2GW solar or wind connection).</p> <p>However, due to existing network limitations it is not possible to accommodate either additional interconnectors or significant volumes of renewables without undertaking major investment in reinforcing the transmission network. This includes the construction of a new line from the south coast to the centre of London (with a long lead time due to consenting and unlikely to be completed before 2025) at an estimated cost of over £500m.</p> <p>The purpose of this project is to demonstrate the potential of smart grid technologies as alternative solutions to network reinforcement. The development and implementation of active network schemes would incorporate both transmission and distribution networks. It is important that these measures are trialled now to ensure any risk associated with the use of such technologies is addressed in a timely manner and without becoming an impediment for day to day operation of the grid. The successful application of this project would facilitate both connection of additional future interconnectors and connection of high volume of renewable generation without the need for major network investment in this area and other parts of the network. The project expected to run from April 2015 until March 2017.</p>			
Estimated Project funding			
<i>The Licensee must provide an approximate figure of the total cost of the project and the NIC funding it is applying for.</i>			
Total cost of Project	£12m	NIC funding requested	£10.5m
Cross Sector Projects only: requested funding from Gas NIC, NIA or second tier LCN Fund?	<i>If yes, please specify</i>		

Problem

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

The South East of England is anticipating significant changes in the way electricity is both generated and consumed. The transmission system is expecting to have to accommodate an increasing number of interconnectors and wind farms. The distribution system will see an increasing volume of embedded generation (solar PV in particular), along with changes to the type of demand such as an increase in electric vehicles, storage and demand side response (DSR). In order to prevent thermal overloading and to manage voltage stability, it is highly likely that significant network reinforcements will be required with both high costs and long lead times.

When interconnectors transfer large amounts of power to or from the UK, the network in the South East will become heavily loaded. If the thermal loading gets too high the network can suffer a voltage collapse which can ultimately lead to a blackout. Additionally the large variation in the amount of loading on the lines (very heavy loading at peak times compared to very light loading at night) causes high voltage issues during times of low demand. The problem is particularly prevalent in and around London due to the large number of cables.

The nature of the changes from the demand side and within the distribution networks are likely to create higher voltages at both transmission and distribution levels, particularly during low demand periods. This would require active management such as paying to constrain local generators to control the voltage. In the longer term, installation of reactive compensation equipment would be needed to prevent future incidents.

In power systems with long distances between connection points (such as in the South East), voltage collapse following a system disturbance may occur. If not mitigated this could lead to a system collapse (a blackout). The mitigation of such an event traditionally requires the building and installation of new transmission lines, use of series compensation, and/or installation of large volumes of reactive power compensation.

Without new economic and efficient solutions to address the aforementioned issues, costly network reinforcements with long lead times will be required. These may delay or limit the creation of new connections for GB consumers, thus limiting the opportunity to utilise distributed resources such as DSR, storage and solar PV.

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.

National Grid is proposing a wide range of measures aimed at comprehensively assessing the strengths and weaknesses of potential smart solutions that could address these growing challenges through enhancing the network capability of the South East network. These measures are aimed to be developed in conjunction with the Distribution Network Operator (UK Power Networks); a fundamental requirement for considering a whole-system approach. These proposals include, but are not limited to demonstration of:

- A. The co-ordinated application of system monitoring at transmission and distribution level using advanced technologies which allow system state estimation without the delays associated with conventional technologies. By having real-time visibility of the network, the performance of the network and the dynamic response to changes in the generation and demand will be evaluated in real time. This will enable quantification of the level of response required from the transmission and DNO networks, and the optimal solution for managing transmission network constraints to be determined;
- B. The application of coordinated control strategies at transmission and distribution systems to

Method(s) continued

enhance voltage stability. This phase of the project provides insight into various control strategies, which enable coordinated decision making at both transmission and distribution level, and help with ensuring voltage stability;

- C. The application of distributed resources to manage transmission constraints. This part of the project will focus primarily on various triggering methods of different services from distributed resources (i.e. DSR, Storage, Solar PV) to help with managing network constraints on the transmission networks; and
- D. Coordinated resource optimisation (optimisation of the numbers of controllable devices) at the transmission and distribution level. This phase, the project aims to demonstrate the effectiveness of coordinating resources (such as conventional reactive compensation, use of HVDC links, as well as new trialled resources) that when proposed as non-build solutions provide maximum benefit for consumers.

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.

The total project costs are estimated to be around £11.7m based on experience from an IFI funded project looking at feasibility of non-build measures. This cost is an approximation to within +/- 25%. The project is currently proposed to have three phases:

- Phase 1 – Demonstration of coordinated system monitoring at transmission and distribution networks and effect of changes on the transmission networks seen at distribution level. This phase of the project aims to maximise the use of existing monitoring equipments, and it is anticipated the funding required for this phase will mainly be spent on developing control schemes (approximately 15% of total cost)
- Phase 2 – Demonstration of control strategies to manage transmission constraints using distributed resources, and the effectiveness of such measures in response to various changes in the transmission networks (approximately 50% of total cost); and
- Phase 3 – Demonstration of coordinated control between transmission and distributed resources and the effectiveness of various combinations at different timescales to manage transmission constraints and provide non-build solutions (approximately 35% of total cost).

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.

As stated in the Electricity NIC Governance Document, the Network Licensee must 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 Network Licensee should outline:
 - *What aspects of the Carbon Plan the Solution facilitates*
 - *The contribution of the rollout of the Method across GB can have in facilitating these aspects of the Carbon Plan*
 - *How the rollout of the proposed Method across GB will deliver the Solution more quickly than the current most efficient method in GB; and/or**
- ii. How the proposed Project could deliver environmental benefits to customers; and*
- iii. The expected financial benefits the Project could deliver to customers.*

The ultimate goal of the SESG project is to demonstrate tools and techniques which can be used to access resources on transmission and distribution networks to enhance network capability without the immediate need to build new infrastructure. This will facilitate the integration of renewables at low cost without the need for significant reinforcement compared to conventional solutions. The network is expected to be more environmentally friendly through improvements in efficiency and by enabling the optimisation of existing assets. The utilisation of smart grid technologies will lead to lower costs, reduced transmission and distribution losses, efficient power production, and optimal asset utilization. These benefits along with eliminating the requirement for building new assets will reduce the carbon footprint of the transmission networks.

A number of solutions proposed for demonstration enable better use of distributed resources such as solar PV, storage and demand side response. This will also enable active and dynamic participation by DNOs to manage transmission constraints. The transformation of the South East network creates opportunities for the DNOs to engage with the suppliers and aggregators to provide the services which benefit the grid, as well as reducing the cost of electricity for consumers.

Following successful demonstration of these technologies as part of SESG, the same concept of using distributed resources could be developed as part of non-build solutions for different parts of the network. The successful rollout of such schemes across the GB power system (at both transmission and distribution level) will accelerate development of new tools at lower cost which will significantly transform the shape of the GB power system in the 21st century. This will result in a significant reduction to the number of reinforcements required and reduces carbon footprint. This can help the economy through new job creation, and new business opportunities for stakeholders.

The key financial benefits of SESG for the South East network include:

- Savings made on network reinforcement, with the potential to provide £500m savings on building a new line; and
- Facilitating the connection of new interconnectors which has an estimated value of over £1bn savings on wholesale electricity price.

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.

As stated in the Electricity NIC Governance Document, the Network Licensee must provide the following to demonstrate compliance with this criterion:

- i. What is the potential Direct Impact of the Project on a Network Licensee's electricity network or on the operations of the GB System Operator;*
- ii. Justification that the scale/ cost of the Project is appropriate in relation to the learning that is expected to be captured;*
- iii. The processes that will be employed to ensure that the Project is delivered at a competitive cost;*
- iv. The expected proportion of the benefits which will accrue to the electricity Transmission System as opposed to other parts of the energy supply chain; and*
- v. How Project Participants have been identified and selected including details of the process that has been followed and the rationale for selecting Project participants and ideas for the Project.*

The NIC funding requested for this project will mainly be spent on the necessary infrastructures required to perform this trial. This demonstration will be focusing on services necessary to provide non-build solutions to defer grid reinforcements. Therefore, the NIC funding associated with this project will be spent on the measures which accelerate achieving greater financial benefits.

Prior to developing this proposal, National Grid has previously worked with number of research institutes, manufacturers and DNOs to perform a detailed feasibility assessment. Subsequently a call for participation was sent to various industry parties which allowed us to better gather their ideas and explore the best type of services for providing greater benefits at lower cost for this demonstration. This has allowed us to have the confidence in the deliverability of these demonstration projects in the most economic and efficient way. This process will continue as part of future procurements required for this project ensuring the tools and infrastructure required are delivered timely and efficiently.

The platform developed as part of this trial will provide invaluable learning on how the use of distributed resources, such as DSR, storage, solar PV etc. in conjunction with transmission connected resources could defer/delay building new transmission infrastructures, and in dealing with power flow volatilities.

Ultimately, the roll out of such a scheme across the GB power system will enable transmission companies to use the non-build solutions more effectively, bringing down transmission reinforcement costs significantly. It will also allow the use of distributed resources to manage some of the design issues at the transmission level, and facilitate deployment of smart grids.

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).

As stated in the Electricity NIC Governance Document, the Network Licensee must provide the following to demonstrate compliance with this criterion:

- i. What new knowledge is intended to be generated from completing the Project;*
- ii. What methodology will be used to capture results from the Project and how the Project's results will be disseminated to other Network Licensees; and*
- iii. Whether the Network Licensee wishes to conform to the default IPR arrangements as set out in Section B: Chapter 9. If the Network Licensee wishes to deviate from the default IPR arrangements it must outline the proposed arrangements, justify why the arrangements are more suitable than the default arrangements and justify how the new arrangements will deliver value for money for customers.*

Constraints within distribution networks are common as a result of increase in the penetration of embedded generation. The expected increase in transmission connected HVDC links, and offshore wind farms worsens these challenges on the transmission level. The tools and techniques demonstrated on SESG are applicable not just to one area of the network, but are extendable across the GB power system and beyond.

As part of the demonstration of this project, given that the partners will be at both transmission and distribution level, a broader platform for such a trial will be created and for the learning to be shared. This will ensure the requirements specific to each part are captured, and therefore by having a "whole-system" approach in solving issues, the best overall solutions will be identified.

To ensure maximum knowledge sharing, we intend to appoint a research institute to provide technical input into the project, as well as lead on publication of the findings at different stages of development. We will also set up an electronic hub for sharing data and providing access to relevant project information. The learning will also be fed every 6 months to the Grid Code Review Panel, and Security and Quality of Supply Standard (SQSS) review panel, as well as shared within Joint Planning Committees (JPC) between Transmission Companies and DNOs. This will ensure the tools and techniques developed are made available for planners to use for future network developments.

This project will conform to the default IPR arrangements.

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.

The work undertaken as part of the NIC project will adhere to the default IPR arrangements. Selection of partners and suppliers will also be influenced by compliance with the default arrangements.

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.

As stated in the Electricity NIC Governance Document, the Network Licensee must provide the following to demonstrate compliance with this criterion:

- i. Why the Project is innovative and has not been tried before;*
- ii. Why the Network Licensee will not fund such a Project as part of their business as usual activities;*
- iii. Why the Project can only be undertaken with the support of the NIC, including reference to the specific risks (e.g. commercial, technical, operational or regulatory) associated with the Project.*

Under the current network design and operation arrangement, there are “tried and tested” conventional tools available to network planners. The cost, risk, and benefits of these conventional tools are known to network planners, hence the solutions proposed are robust. Therefore, until any new tool provides the same level of confidence in terms of “operability”, it cannot be used by network planners. This is to ensure no extra cost, in addition to the cost of reinforcements identified, is passed to the consumers which, is due to the risks imposed by using these technologies.

This project aims to perform an in-depth risk assessment as part of the trials, covering a range of potential blockers/risks including:

- Mitigation of the risks associated with control system delay and reliance on tools and techniques which require fast acting control systems;
- Mitigation of the risks associated with the use of distributed resources, and potential conflict of services (i.e. DSR providing balancing services at the same time);
- Mitigation of risk of failure of distributed resources (3rd party equipment) to respond;
- Mitigation of control interaction of distributed resources when instructed to respond to a common signal and risk of common mode of failure; and
- Mitigation of risk of interaction between distributed resources with transmission connected devices.

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? (Continued)

This will be done via a series of trials under different network conditions resulting in a comprehensive assessment of network behaviour.

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.

Following identification of NIC 2014 project candidates National Grid engaged with a range of external stakeholders; this was achieved through a request for project proposals. Briefing notes outlining the project candidates were made available on the NationalGrid.com website within the Innovation section; direct contact to relevant customers, suppliers and partners was made to raise the awareness of these briefing notes.

Currently, a number of technology providers, the south eastern network licence area of UK Power Networks (South Eastern Power Networks plc), a demand side aggregator, storage providers, and Universities have shown interest in becoming a partner(s) on this project.

UK Power Networks will participate to undertake, as the relevant Distribution Network Operator, elements of work funded by the project and have agreed in principle to make a partner contribution to the project.

Final decisions on partners and suppliers have not been taken at this time. Wherever appropriate competitive procurement will be used to ensure value for money is achieved.

Derogations or exemptions

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

No derogations or exemptions will be required as part of SESG project.

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).

Customer interaction will only be with those who participate as project partners; as such, they will be closely involved in scoping the demonstration activities.

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

National Grid recognises the opportunities for SMARTer network development which can be made available through using distributed resources. Therefore technologies such as DSR, storage, solar and wind may provide significant benefits for more efficient design and operation of the grid; improving the value of our services for customers. This strategy was also discussed in our Electricity Ten Year Statement published in 2013.

We held a number of stakeholder engagements on these topics to identify the areas that have higher priority, and those which require NIC funding. We have also reviewed the NIA/IFI/LCNF projects to avoid any unwanted potential overlap as well as finding ways of incorporating the learning from these projects into our submission. This allowed us to develop our South East Smart Grid (SESG) proposal aimed at increasing network capability using non-build solutions, driven by an increase in connections at both transmission and distribution level. The strategy used in developing this project is to trial a number of technologies, identify/mitigate potential risks and create tools to roll out these measures across the network.

We strongly believe and are committed to the fact that non-build solutions have the potential to provide greater benefits for consumers. At this time, the risks and uncertainties associated with the use of distributed resources as non-build options may in fact increase the cost; undermining their value. Therefore, we aim to address these issues as part of this NIC project to make them available for future network reinforcements.

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