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, 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 11 pages in total. **Ofgem will publish all the information contained within the Screening Submission.**	
Funding Licensee	
National Grid Electricity Transmission Plc	
Network Licence Project Partners	
Funding Licensee area	
National Grid Electricity Transmission Plc	
Project title	
Enhanced Frequency Control Capability (EFCC)	
Project Summary	
The Licensee must provide an approximate Project start and end date.	

Decarbonisation of the electricity industry will result in significant changes to the generation mix. To meet the UK carbon reduction targets there will be a requirement for a significant increase in volumes of both wind and solar powered generation. Such changes in generation mix reduce the system inertia, giving rise to an increase in the volume and speed of frequency response required.

There is no provision for trialling new services as part of business as usual; particularly those which require new infrastructure or contract with service providers for the purpose of demonstration. If we continue to utilise the existing process and techniques available for managing frequency control, the operating cost is anticipated to increase from around £60m per annum to £200m-£250m per annum by 2020.

The objective of this project is to develop and demonstrate an innovative package of tools, which provide the capability of delivering enhanced frequency control, in order to ensure that we can continue to manage the system frequency and minimising the operating costs. The successful development and implementation of this project may result in a saving to the end consumer of £150m-£200m per annum.

The project is expected to run from April 2015 until March 2018.

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	£10.3m	**NIC funding requested**	£9m
Cross Sector Projects only: requested funding from Gas NIC, NIA or second tier LCN Fund?	*If yes, please specify*		

Problem

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

System frequency is the key indicator of the real time balance between generation and demand. The system frequency is traditionally controlled via generator units set to be in 'frequency response mode', so they respond to changes in system frequency (frequency incidents) by altering their power output. These changes in system frequency are due to imbalance between generation and demand caused by instantaneous faults. In a system with high rates of change of frequency it is desirable:

- To minimise the delay between the moment a frequency change occurs and the time the response is delivered; and
- To ensure that a sufficient number of response providers have the capability to respond rapidly.

One of the key contributors to the strength of a power system is the system inertia, which is sum of the stored energy in the rotating masses of the synchronous generators and motors. The lower the system inertia, the lower the system's capability to withstand the changes in system frequency. When the majority of energy supplied to the grid is provided by synchronous machines (such as thermal plants), there is a high level of system inertia available due to their inherent design. However as the proportion of energy supplied by non-synchronous generators (such as solar PV, wind and interconnector) increases, the overall system inertia will decrease.

One of the consequences of a reduction in system inertia is an increase in the rate of change of frequency during frequency incidents (sudden loss/increase of generation or demand). To manage this increase in volatility, various approaches are possible:

- Maintain larger volumes of frequency response (more generators contracted to be in frequency responsive mode);
- Constrain the largest generation or pump storage/interconnector in export mode; and
- Run additional synchronous generation in the place of non-synchronous generators such as wind turbines.

These approaches would significantly increase the cost of ancillary services, reduce the efficiency of the power system, and negatively impact the environment due to inefficient operating point of generators.

When a control system acts to manage system frequency, the response must not only be fast but stable. As mentioned above, a fast response to a high rate of change of frequency is highly desirable; however a very fast response could lead to oscillations. With current control techniques there is a risk that local controllers could make the wrong decisions due to variations at the local level. The impact of such decisions can range from minor undesirable oscillations which over time affect the lifetime of a generator, to active power overshoots which detrimentally impact overall system frequency.

In short, innovative solutions are needed to deliver control systems which are both fast-acting and stable, and such solutions will become increasingly valuable as we move towards a low carbon future.

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.

The technical constraints of achieving an enhanced frequency control capability in the grid need to be addressed via a package of innovative works, which are proposed in this project. The feasibility assessment of these activities has already been carried out as part of some NIA/IFI projects as well as substantial in-house work. Therefore this project intends to build on those and:

1. Demonstrate a new instruction /detection/ activation method for primary response
    - Based on rate of change of frequency (df/dt) rather than absolute frequency
    - In proportion to the rate of change of frequency (df/dt)
    - Region specific: considering regional variations in the rate of change of frequency at the timescale required for an enhanced frequency control capability

2. Demonstrate the effectiveness of providing frequency response via the new method from transmission and distribution connected resources including renewable generation technologies and demand side response
    - Demonstrate the optimisation of frequency response in order to provide the most economic and efficient rapid frequency response under different system conditions:

Method(s) continued

- For different generation and demand levels
- For different rates of change of frequency

The demonstration and trial of this work package allows for the development of new balancing services and capability in the grid to mitigate the reduction of system inertia and effectively managing system frequency containment.

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 £10.3m based on experience from existing activity and an IFI/NIA funded feasibility assessment. As the details of the technology which will be deployed have not yet been confirmed, this costing is an approximation to within +/- 25%. The costing is also highly sensitive to the number of potential service providers and technologies we engage with in the full project, which is yet to be concluded.

The project is currently proposed to have three distinct phases:

- Phase 1 – Developing new control systems capable of initiating frequency response in proportion to the rate of change of frequency at a regional level. This requires around 20% of the total funding.
- Phase 2 – Demonstration of frequency response delivered from various response providers and assessment of their capability. This requires around 50% of the total funding.
- Phase 3 – Demonstration of optimisation of the coordination of frequency response from multiple providers in order to define the potential service model. This requires around 30% of total funding.

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.

An increase in the penetration of wind and other renewables, reduces the system inertia and this increases the need for more frequency regulation services. EFCC is determined to address this issues by providing the opportunity for diversifying the frequency control market. This will facilitate deployment of renewable energy across the UK while minimising extra operational cost which is passed to the consumers.

In addition, by providing the capability in the grid for smaller generation units and DSR to help with grid frequency control, new entrants are encouraged to compete with existing participants. This makes the frequency response market more competitive and reduces the cost and carbon impact of frequency control methods. The reduction in carbon production at operational timescale is further achieved by the ability of thermal plants to run at more efficient operating mode.

Successful implementation of EFCC removes the technical challenges facing the grid in managing the increasing penetration of non-synchronous generation. Existing measures cannot provide a means of managing high penetration of wind and solar with regard to frequency control. Neither, they are capable of using wind and solar as an opportunity to utilise these resources for grid frequency control.

The cost of frequency control in the future is in the region of £200m-£250m per annum by 2020 if no new measures are made available by then. By eliminating the need for carrying extra response, balancing costs will reduce, resulting in savings in the region of £150m-£200m per annum for consumers.

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.

There are a range of challenges for the grid operator when dealing with increasing penetration of renewable generation. Solutions and measures need to be developed ahead of the challenges to avoid excessive cost to the consumers. The EFCC project aims to demonstrate a range of tools which enable the most economic and efficient measures to be developed in a coordinated manner. This includes but is not limited to:

- Potential reduction in frequency response requirement and reduction in cost by having the enhanced capability to monitor grid conditions affecting both generation and demand by using Wide Area Monitoring devices.
- Provide potential for increase in consumers' participation in providing grid frequency control, and developing services which help reducing the electricity bills.
- Ensuring the solutions required are identified ahead of the challenges, resulting in costs for GB consumers.

Given the above challenges and opportunities, National Grid has already performed stakeholder engagement to seek industry's view on how to resolve these challenges. National Grid has engaged Distribution Network Operators (DNO) via Energy Networks Association (ENA), supplier and service providers via commercial services, and universities and research institutes via direct contact over the course of the last few months proposing this project. This engagement provided assurance that a sufficient market exists to ensure that the solutions proposed by the project can be delivered in the most economic and efficient way; delivering value for the consumers. This process will continue as part of future procurement for this project.

This project will significantly help with facilitating more economic and efficient frequency control of the GB power system. In addition there are substantial opportunities as part of developing this approach for suppliers, demand side aggregators, embedded generators, and renewable generators. These benefits will ultimately increase the competition, lowering the cost of delivering the product, by creating more opportunities in the electricity market.

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.

Some of the key learning aspects of the project include:

- Developing control systems able to detect / distinguish system disturbances and frequency events to trigger reliable response: emerging and maturing technologies will maximize the use of the transmission system, strengthen the safe and reliable operation of the grid, improve overall market efficiency, strengthen the provision of frequency response, and advance environmental policy objectives.

- Provide capability within the demand side to widen their participation in grid frequency control: As electricity flows at the transmission and distribution level become more diverse and volatile, the network operator will need to play a more active role in managing the network by encouraging consumers to participate in technologies such as DSR, Solar PV, and other micro-generation projects, which contribute to a reduction in carbon emissions.

- Allow integration of the learning of this project into the economic decision making of operating the system and optimising the balancing services required to run the system in the most economic and efficient way.

The project will form a working group with industry representation (manufacturers, academics, suppliers, aggregators, generators, and network licensees) to monitor the progress at different stages and ensure the deliverables are challenged and reviewed. This will also ensure continuous knowledge sharing with the industry to accelerate service and technology developments in this area. As part of this, we will set up a knowledge sharing hub (in the public domain) to also allow the use of data and learning of this project by academic institutes, as well as showing leadership in this important area internationally.

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.

The measures currently available to deal with frequency control are designed to provide a cost effective way of optimising frequency response requirement. There is no provision for trialling new services as part of business as usual; particularly those which require new infrastructure to be built for the purpose of demonstration. There are various risks associated with trialling new services, such as communication, measurement quality, control systems, and for plants which are to respond to new signals.

The EFCC aims to mitigate various risks such as:

- Risks of ability to successfully measure the disturbances on the grid, and determine which events require frequency response (control and communication risk mitigation)
- Risk of sending command signal and signal latency (communication risk mitigation)
- Risk of service providers having to respond to such signals rapidly and the impact on the devices (asset risk mitigation)
- Risk of service providers having to operate at sub-optimal level to provide response (commercial risk mitigation)

These risks, until mitigated as part of this project, prevent us from defining new services and to be able to procure them in the most economic efficient way, which will be of benefit to consumers and the industry.

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)

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. In addition, National Grid used a number of forums such as ENA, Commercial Operation, and via direct contact with university partners to share the 2014 NIC project candidates.

The responses received provided a deeper understanding of the capability available to successfully take forward the NIC 2014 project candidates. Given the nature of the EFCC project, we are confident that DNOs will be involved. The main reason for engaging with the DNOs is to have a whole system approach in doing such a project. Beyond this, demand side aggregators, a solar PV owner, a windfarm owner, as well as a technology provider are on the list of our proposed partners.

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 EFCC 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).

N/A

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
The changes in the generation mix expected in the future will have a material impact on grid frequency control. The increase in wind and solar may increase the frequency control cost if no new measures are made available to deal with such massive changes, and to utilise some of the opportunities and capabilities which come as part of this change. The increase in the cost of frequency control can be mitigated by demonstration of the package of works described in this submission to ensure the tools and techniques are made available. The NIC funding will be spent carefully on demonstrating the tools and techniques on which we have previously done sufficient levels of feasibility assessment and research. The demonstration using NIC funding removes the technical and commercial risks associated with rolling out new services, ensuring these new measures provide maximum benefit for the consumers and reduce costs. The approach proposed for this project aims to take a holistic view regarding the type of services and service providers, ensuring a whole-system approach to support grid frequency control. Such an approach when used in the roll out of new services will make the frequency control market more competitive and diverse. The new service providers will be able to participate in the grid frequency control market which will drive technology improvement and help with meeting carbon reduction targets, as well as ensuring the services are delivered at optimal cost.

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