Electricity/Gas Network Innovation Competition Screening Submission Pro forma

Notes on completion		
Before completing this form, please refer to the relevant Network Innovation Competition (NIC) Governance Document(s). Please use the default font (Verdana size 10) in your submission. We will only accept the text visible in the text entry areas. 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 this Screening Submission.		
Is the application for the Gas or Electricity NIC?	Gas NIC ☐	Electricity NIC ☒
Cross Industry Project	YES ☐ *If yes, please fill out Cross Industry Projects section*	NO ☒
Funding Licensee(s)		
National Grid Electricity Transmission Limited		
Network Licensee Project Partners		
We are currently in the process of forming a partnership with Distribution Network Owner(s), 5 out of 6 have responded citing their interest.		
Funding Licensee area(s)		
National Grid Electricity System Operator and selected DNO Partner(s)		
Project Title		
Black Start from Distributed Energy Resources		
Project Summary		
The Licensee(s) must provide an approximate Project start and end date.		
As Great Britain's System Operator (SO), we are responsible for restoration of GB's electricity network following the unlikely event of a full or partial blackout. Our current approach is based upon the gradual deployment of large generation blocks that energise increasingly larger sections of the transmission network. The economics of keeping these generators online is worsening due to rising fuel and carbon costs, which combined with falling costs of alternative technologies results in traditional thermal generators rarely being warm, and in an increasing number closing down permanently. Consequently, the cost of procuring Black Start services from these large generators is increasing, a trend that is unlikely to be alleviated without intervention. A lower number of these providers will result in a slower blackout recovery. Distributed Energy Resources (DERs) are becoming much more prevalent as costs fall and end-user appetite increases. The SO has a responsibility to evolve restoration methods in line with generation mix changes to ensure an efficient and economic restoration plan for GB. This project, running from Jan 2019 for approximately 4 years, aims to understand how a combination of conventional and renewable DERs can effectively contribute to GB Black Start and restoration, and how the approach can be coordinated across the whole electricity system.		
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	£10m	**NIC funding requested** £9m
Is the TRL of the Project at start date between 4 and 8?	YES ☒	NO ☐
What is the Problem?		

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

Large coal and gas generators, which currently provide the majority of Black Start services to the SO, are forecast to decline by 85% from 38GW installed capacity in 2018 to 6GW in 2050. This is driven by emissions regulations and worsening economics (marginal electricity, fuel and carbon prices). Furthermore, those that remain online will only be cost-effective to run some of the time, so will be available ("warm") less often. Therefore, they will need more financial support to stay connected and available to provide Black Start – increasing the cost to consumers.

Furthermore, if we continue to largely rely on large thermal generators for Black Start services, having fewer of them on the system will inherently have an adverse impact on speed of restoration, should a blackout occur.

Distribution-connected generation capacity is forecast to increase by 130% to 72GW by 2050. As well as renewables, and the ever increasing number of battery energy storage systems, there is more thermal generation, such as biomass, CHP, and gas generators connecting to the distribution network . Looking ahead, it is inevitable that emerging technologies such as EVs, heat pumps and Demand Side Response (DSR) will play an important role in the electricity system. These solutions present a great potential opportunity to contribute to Black Start and restoration, but there are a host of technical, operational, commercial and regulatory issues that need to be addressed:

Technical – can different types of DERs meet the requirements for Black Start and local restoration? What kind of distribution network characteristics and DER and demand makeup are appropriate? How will equipment need to change? How can Black Start and restoration adapt?

Operational – how can SO, DNO, service providers and other stakeholders best be coordinated? How would communication and control work during a black out? How would organisations need to adapt?

Commercial and regulatory – should there be consideration of mandatory elements in combination with commercial elements of a service? What changes would need to be made to contracts and codes? How do the economics of Black Start services change when the number and geographic dispersion of providers increases?

The possible solutions to these issues are numerous and need to be worked through and validated in detail, to ensure we find a suitable enduring solution and do the right thing for GB consumers.

What Method(s) will be used?

The Licensee must describe the Method(s) that 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.

Overview

The project will be structured in 4 phases:
1. Feasibility Stage – Understand the current state and future scenarios, identify and address specific issues.
2. Design Stage – Develop preferred solutions and create test specifications.
3. Offline Testing – Test the approach offline at 11kV test facility and undertake desktop industry simulation.
4. Online Testing – Test DERs and coordination processes online at suitable DNO locations.

Each of the phases will consider the Technical, Operational, Commercial and Regulatory requirements to be able to achieve a solution to the problem.

Following successful completion of all 4 stages, and cost-benefit analysis, the project aims to have proven that DERs are a viable solution to provide Black Start services, and to have provided a commercial and regulatory framework for how Black Start from DERs can be purchased and regulated. The solution will then be included in the Black Start Strategy, and the Procurement Methodology and restoration plans will be updated to reflect the new findings.

Method(s) continued

1. Feasibility Stage – analyse the challenges and potential solutions in depth, and arrive at a recommended approach.

Technical – build on work already done in GB and internationally. Complete a comprehensive review of DER capability to provide Black Start energisation and contribution to a system restoration, considering all current and likely future DER technologies. Undertake whole power system studies to understand the ability to Black Start and restore from DERs in various distribution network scenarios (voltage, topologies, demand and DER makeup), today and in the future.

Operational – evaluate the options for coordination (roles and responsibilities) as well as communication and control infrastructure and processes. Assess the impact of the proposed approaches on the organisational structures and required skillsets of participants.

Commercial and Regulatory – based on the technical and operational requirements and capabilities, review and assess contractual arrangements, regulatory frameworks and codes to understand the required changes.

An initial cost-benefit analysis of the preferred approach(es) will be created to assess value for money for consumers.

2. Design Stage – take the preferred approach(es) from the Feasibility Stage and design the detailed specifications, frameworks and processes that will enable them to be trialled.

Technical – develop and document DER and network technical requirements.

Operational – design a solution for the coordination approach (roles & responsibilities).

Commercial and Regulatory – propose the changes to contractual and regulatory mechanisms.

Cost-benefit analysis - update the cost-benefit analysis to reflect more detailed design.

Scope the testing stages – create offline and online test specifications, methodologies and success criteria for DERs, network equipment, communication and coordination.

3. Offline Testing – validation of approach.
Technical - perform offline tests on an 11kV test environment in order to de-risk the coordination approach prior to field trials, and to characterise how DERs and networks behave during Black Start and Restoration.

Operational – conduct a network-wide desktop simulation to validate the proposed coordination methods in different scenarios.

4. Online Testing – validation of solutions developed.
Implement changes (e.g. protection settings) to DERs and network equipment in the trial area(s), and test their effectiveness. Prove that DERs can Black Start, energise and synchronise. Test the coordination approach. Note: this test will not impact any customers.

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 ~£10m. This cost is an approximation, and we would foresee final costs being within +/- 25% of this. The costs of each Phase of the project should be as follows: Phase 1: Feasibility Study ~40% of costs Phase 2: Design Phase ~20% of costs Phase 3: Offline Testing ~20% of costs Phase 4: Online Testing ~20% of costs A comprehensive project costing will be provided in the final bid submission.

Which Specific Requirements do the Project fulfil?(Please tick which of the Specific Requirements this Project fulfils)

	Electricity	**Gas**
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/gas transmission and/or distribution equipment (including control and communications systems software)	☒	☐
A specific novel operational practice directly related to the operation of the electricity/gas transmission and/or distribution systems	☒	☐
A specific novel commercial arrangement	☒	☐

How does the Project accelerate the development of a low carbon energy sector & have 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.
The project will contribute to the UK's Clean Growth Strategy by accelerating the development of a low-carbon energy sector in two ways: 1. If successful, the project will enable DERs incl. renewable generation to deliver Black Start services to the SO, potentially displacing the carbon emissions associated with the equivalent large, CO2-emitting generators being online and warm. 2. Black Start services may represent a new revenue stream for distribution-connected low-carbon technologies, such as renewables and storage amongst other newer solutions, which will in turn improve their investment case going forward, thus accelerating their deployment. Within our full submission, we will provide an estimate for the CO2 savings that would be achieved from a sample DER-led Black Start and restoration approach vs the counter-factual transmission-led approach. The project will also deliver net financial benefits to consumers: Prior to 2016/17 the SO's total spend on black start was consistently around £20-25m p.a. However, forecast costs for 2017/18 are in the region of £50m. This rise in costs is due to the limited lifetime and worsening economic conditions for traditional providers, as well as the onboarding of new large providers. In contrast to this, DER technologies are set to become more competitive, with some already achieving cost parity with traditional generation (evident from the success of DERs in recent Capacity Market auctions). Opening the market to DERs will counteract the effects of increasing prices from a smaller pool of traditional providers, by increasing competition and liquidity, driving down costs and creating savings for consumers. Recent modelling suggests that an average GB shutdown would result in a cost of £10bn to the GB economy today, based on a Value of Lost Load (VLL) of £12k/MWh. If we do not enable new sources of Black Start services to enter the market, the duration of restoration is likely to increase (as fewer Black Start-enabled generators exist). Modelling suggests that a doubling of restoration time is likely to double or treble the economic impact, so mitigating the risk of increased blackout duration is extremely valuable, should the event occur. This does not take into account any additional safety and welfare costs of a prolonged outage. Our full bid submission will also estimate the net financial savings that would be achieved from a typical DER-led Black Start and restoration approach vs the counter-factual transmission-led approach, based on actual costs as well as on future projected scenarios.

How will the Project deliver value for money for electricity/gas customers?

The Licensee must demonstrate that the Method(s) being used can derive benefits and resulting learning that can be attributed to or are applicable to the electricity/gas transmission and/or distribution systems.

The project will build upon existing work, incl NIA projects and a whole-system System Operability Framework (SOF) report. It will liaise closely with Ofgem and industry working groups at BEIS and Energy Networks Association (ENA) Open Networks, and with relevant NIC projects such as Power Potential, Fusion, Transition and EFFS. This will ensure that synergies are maximised and duplication is minimised.

The methodology will produce a minimum viable product of technical, commercial and regulatory frameworks to test. This will minimise the risk of overspending on unsuitable solutions. The project will look to build upon existing infrastructure and processes as much as possible.

The project will have a direct impact on the SO by opening up the Black Start market to a host of new providers thus improving its liquidity (and lowering costs), and giving the SO confidence in the fact that the approach is viable.

TOs and DNOs will benefit from a more reliable, future-proof, and efficient approach to restoration. The end result should be that in the unlikely event of a blackout, services to consumers should be restored in a cheaper, cleaner, more timely and efficient way.

If any hardware is required to be procured / built, we will undertake a competitive tendering process.

As outlined in the previous section – the potential benefits to consumers could far outweigh the project investment if successful.

How will the Project generate knowledge that can be shared amongst all relevant Network Licensees?

The Licensee must explain the learning that it expects the Method(s) to deliver, and how it will be shared. The Licensee must demonstrate that it has a robust methodology in place to capture the learning and how the learning is disseminated.

The learnings and results from this project will be directly applicable to a wide variety of GB energy stakeholders:

1. DNOs will understand how to assess the most appropriate locations for Black Start and restoration services on their networks, and what changes / adaptations to their network, communications and control systems would need to be made.
2. DERs will learn how their technology could provide Black Start and restoration services, what the technical specifications entail, and how testing will work.
3. Ofgem will be presented with a proposal for how electricity network codes could be improved to facilitate this new market.
4. All market participants will be able to understand how this market will work commercially, what example contracts may look like, and what the value of the service may be.

We will create a project Steering Group so each key stakeholder group will have a representation to influence the project's direction.

Results of each stage will be documented and published, as will 6-monthly progress reports and a completion report.

We will work closely with, and regularly disseminate learnings to the ENA, Ofgem, BEIS, and to the industry at regular events and conferences and through reports, presentations, workshops and seminars.

A comprehensive dissemination strategy will be submitted with the full bid proposal.

Does the Project conform to the default IPR arrangements set out in the NIC Governance Document?	YES ☒	NO ☐

By selecting NO, the Licensee wishes to deviate from the default requirements for IPR. If this is the case, it must demonstrate how the learning will be disseminated to other relevant 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 project conforms to the default IPR arrangements set out in the NIC Governance Document.

How does the project demonstrate it is innovative (ie not business as usual) and has an unproven business case, that the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness?

Demonstrate why the Licensee has not previously used this Method (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 Project as part of its business as usual and why the Solution is not Research.

Black Start from Distributed Energy Resources is a completely new, untested and unproven approach for GB restoration. There are a host of technical, operational, commercial and regulatory challenges that as yet remain unaddressed, and we need to explore innovative new approaches to solve them. It could be inefficient and costly to design a DER-led market for Black Start without de-risking the approach by exploring, assessing and testing all of the options.

There is a high level of technical and operational risk associated with Black Start from DERs, including the ability of the DERs to respond and restore, to the distribution network to be able to energise upwards, to the resilience of communications in a blackout scenario.

The commercial risk of adopting a new Black Start approach is significant:
1 – for the market participants (SO, DNOs, TOs, DERs), designing the approach badly would result in significant financial penalties if the approach goes wrong
2 – it is estimated that an average GB shutdown would currently cost the economy ~£10bn. Doubling the restoration times could double or treble the economic impact.

For these reasons, it is essential that the various innovative options are worked through first in a safe environment, and that all conclusions are tested and validated before rolling out GB-wide.

How were project Partners, external resourcing/funding identified, and what are their roles?

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

The SO will partner with TNEI, an independent specialist energy consultancy providing technical, strategy, environmental and consenting advice across conventional and renewable energy sectors.

In October 2017 the SO made a public call to Non-Network Licensees for ideas that addressed our Innovation Priorities. We were pleased to receive 37 submissions to the invitation, which then prioritised via robust internal process that considered the SO Innovation Priorities. TNEI's proposal was chosen to be taken forward.

We have engaged with all DNOs, and 5 out of 6 have formally expressed interest to be a project partner. Several DNOs have provided guidance for our scope to date. Following submission of this ISP, we will be undertaking a more rigorous assessment of each of the interested DNOs to prioritise those with the most appropriate network characteristics for this project.

We have also engaged an 11kV test facility who have provided expert advice for our offline testing phase, as well as two firms that specialise in communications technologies that we will be looking to test.

We will also be engaging with DER Original Equipment Manufacturers (OEMs) as well as DER owners and aggregators throughout the course of the project. This will involve engagement in Phases 1 and 2, and partnering to test DERs in Phases 3 and 4.

Will the Project require any derogations or exemptions?

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

We do not expect to require any derogations or exemptions.

How will the Project activities impact customers?

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).

We do not expect any impact on customers during the trial, but the project outcomes will significantly benefit customers if successful.

What funding is being requested from each NIC? (Cross Industry Projects only)

The Licensee must outline funding that is being requested from the Electricity and the Gas NICs and include a justification for the funding split.

N/A

Are there any further details the Licensee feel may support its submission?

All data on current and future market generation has been taken from the 2017 Future Energy Scenario – Slow Progression (generally used in cross-industry Black Start work). However, similar conclusions about the changing mix of generation and energy resources on the system may be drawn from any of the Future Energy Scenarios.

Work that this project will build on:

In 2015 the SO initiated two Network Innovation Allowance (NIA) studies which concluded that the SO strategy for Black Start needs to look beyond the current pool of providers, and that further work is required to validate the ability for renewables and embedded generation to provide Black Start services.

In 2017, the SO along with 2 DNO partners (SPEN and NPG), published a System Operability Framework report on Black Start from Distributed Sources. This identified that the key challenge for the approach was around the roles and responsibilities of the various market players.

In 2017 we published our Black Start Strategy and Procurement Methodology, and our System Needs and Product Strategy. In both we clearly indicated the need for new sources of Black Start services.

We continue to work with BEIS and the Energy, Emergencies Executive Committee to explore new avenues for restoration, including how wind generation could contribute.

Internationally, we have engaged with the Italian and Southern Australian Transmission System Operators about their blackout events, incorporating learnings into our own strategy.

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