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 Verdana size 10 font in your submission. The text entry areas are suggestions and the size of each text area can be altered if you need to provide more information in one section and less in another. In all cases the full-completed submission should not exceed **11 pages** in total.

Ofgem will publish all the information contained within the Screening submission.

Funding Licensee

SP Transmission Plc (SPT)

Network Licence Project Partners

To be finalised

Funding Licensee area *(or where the licensee does not operate in a specific area the geographic location(s) of the Project)*

SP Transmission Area

Project title

Future Intelligent Transmission NEtwork SubStation (FITNESS)

Project Summary

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

FITNESS will demonstrate sustainable design, deployment and operational control of a SP Transmission substation, using innovative protection, control and information technologies. The challenge addressed in this project is to demonstrate that innovative digital solutions for substation can be applied in a standard, scalable approach, suitable for future Business-as-Usual (BaU) implementation, delivering improved network performance, capability and flexibility at lower cost.

Aligned with the SPT's RIIO T1 Transmission Innovation Strategy Review (2014), FITNESS will ensure interoperability, intelligence and visibility in transmission operations and will aim to:

- Demonstrate that new protection and automation solutions, based on IEC 61850-9-2 process bus standard deployed live for the first time through this project, are applicable for use on the GB transmission network.
- Demonstrate that innovative solutions will be interoperable with existing conventional system to optimise asset replacement.
- Accelerate towards a future modernisation approach with reduced primary plant outage and commissioning time
- Accelerate towards standardised wide area control implementation leading to robust and less bespoke solutions for increasing asset capacity.

The project is expected to commence in January 2016 and planned to come to successful conclusion by August 2019.

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**	£8.2m
Cross Sector Projects only: requested funding from Gas NIC or NIA?	*If yes, please specify* N/A		

Problem(s)

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

The problem of an aging asset base and continuing rapid rate of new renewable connections places investment costs and capacity demands on both the GB TOs and the System Operators (SOs). The length of time to design, instrument and commission a substation, and obtain planning consents, represents a significant element of the lead-time for connecting renewables to the system, improving network capacity and replacing aging assets. For example In SPT's RIIO T1 asset plan, ~300 bays (switchgear, transformer) are planned to be refurbished. The issues related to refurbishments and future modernisation approach, addressed in project FITNESS include:

- **Complex management of reinforcements and modernisation** because of:
    - Limited opportunities for taking **extended outages**; (shorter outage periods will not only reduce total outage time, but also improve flexibility of outage scheduling) (Method1).
    - Efficiency of planning and delivering projects is constrained by the limitations of conventional technology and costs involved (Method1).
- Renewable generation connection can be constrained by the rate of network development. Wide area monitoring and control options are needed to extend network use, mitigate risks and co-ordinate T&D networks. (Method3).
- Secondary equipment is replaced within the primary plant lifetime, requiring **further outage scheduling** (Method1).
- The **interoperability of novel digital solutions with conventional equipment** needs to be proven both within the substation and at each end of a transmission line. This is particularly important to generate confidence in advanced power system protection solutions (Method2).

As the substation and control centre solutions are becoming more complex with increased number of intelligent electronic devices (IEDs), there is a greater need for increased situational awareness, information gathering and management. Currently identified **information challenges** include:

- The **data issues of data quality and validation, and information extraction** of key automation features. In particular, use of wide area information in automated control and critical operational systems could be significantly extended by addressing the end-to-end information system robustness (Method3).
- Modern IEDs have much greater information and processing capability than is currently used, but **equipment diversity and lack of an integrated analytic framework** restrict system operators from making use of their available full potential (Method3).
- With increasing variable renewable generation and power electronic sources, the **risks relating to harmonics and short circuit capacity** (thus protection reliability) are increasingly challenging, and there are needs for active control to make efficient and secure use of assets (Method3).

The need to reduce these time-delays, deliver faster and simpler installation process, with a smaller footprint, at the same time improving the quality of information supplied to operational users and analysts is a key motivation for this project.

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.

SP Energy Networks (SPEN) in collaboration with other project partners aims to design and demonstrate following technical solutions at 275kV level in SPT Area. The project aims to bring forward learning outcomes of research carried out in various NIA and NIC projects and demonstrate the implementation in a live substation environment.

Method1: Accelerated Substation Secondary Side Modernisation

Pilot digit substation concept using IEC 61850-9-2 standard in a live 275kV substation environment, incorporating

- Non-Conventional Instrument Transformers (NCIT) – optical voltage (VT) & current. This project will be one of the first installations of a newly commercialised optical VT in the UK. Trial of novel distributed sensor technology integrated via 61850*.
- Protection solutions, with innovative hot standby design to enhance reliability and availability and improved time synchronisation using latest precision time synchronisation IEC 1588v2 standard*.
- Interoperability of multiple vendor equipment using IEC 61850-9-2*.

Method2: Comparative and Interoperability Analysis of Modern and Conventional Technology

- Comparative performance review of NCIT and conventional transducer, to establish whether shorter fault clearing time and raised stability constraints can be achieved.
- Interoperability between NCITs, distributed sensors and conventional transducers through IEC 61850-9-2 Merging Unit, and matching line end protection across substations.

Method3: Increased Situational Awareness and Enhanced Information Management

Innovative information management between substation and central applications including:

- Phasor-capable substation topology processing and linear state estimation, for high quality data and unified data management between substation and central system.
- Intelligent reporting in real-time to improve informed operator decisions.
- Adaptive protection settings & voltage control based on wide area information*.
- Multi-ended fault location using 61850 measurements (i.e. without specialised transducers), integrated with wide area view & report.
- Innovative applications such as harmonics mapping at substation and system level and voltage control by capacitor switching, sensitive to system state across the network.

Method4: Network Security

- Deploying such a system requires data flows to several disparate systems which themselves have security constraints. This project will investigate the options for delivering such connectivity in a secure manner and enable secure remote access*.

* Denotes knowledge captured from NIA and NIC projects.

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 funding estimates are based on SPEN's experience of substation work and experience of managing innovation projects such as the NIC VISOR. The accuracy of the funding estimate will be further improved during detailed design in support of the full submission.

The approximate project cost of £10m can be divided between the proposed work packages (WP) tentatively as follows:

WP1/Method 1:	Digital Substation Design, Installation and Commissioning (20%)
WP2/Method 2:	Interoperability and Performance Comparison (20%)
WP3/Method 3:	Integrated Information Management, WA Control & Situational Awareness (40%)
WP4/Method 4:	Network Security and Communication Infrastructure Requirements (10%)
WP5:	Knowledge capture and dissemination (10%)

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 and/or distribution equipment (including control and communications systems software)	✓
A specific novel operational practice directly related to the operation of the electricity transmission and/or 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 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.

UK's Carbon Plan directives indicate "Reform of the Electricity Grid" should be achieved by "paving the way towards a 'smarter' electricity grid in the UK, which will increase the efficiency and reliability of the network, enable flexible demand management and the use of electric vehicles, and support integration of more local and wind-powered generation". The project **FITNESS** will support this directive in its methods to develop "**fit for future**" substation protection and automation solutions.

(contd.)

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

i. SPEN will actively engage with, and inform, TOs, SOs, OFTOs and DNOs in the UK regarding the design, deployment and outcomes of the project and consequently all customers will benefit from the increased confidence and hence faster adoption of following deliverables:
   - Accelerated development of digital protection, automation solutions and intelligence within substations to facilitate improved asset replacement and management. It will build confidence that the underlying reliability of existing designs is not degraded by new technology.
   - Novel instrumentation technologies are non-disruptive, reduce use of oil and gas at substations and minimize impact of failure on surrounding plant and primary equipment, thus improving operational **reliability** and **safety**.
   - Faster reaction time to faults due to improved information management and increased situational awareness will enhance operational **efficiency** of the network.
   - Intelligent integrated wide area control provides opportunities for reducing constraints and support **integration of local and renewable generation**.

ii. The following environmental benefits not only relate to renewable generation connection, but also to the design and lifecycle of substations, all of which in turn will reduce the dependence on carbon and energy intensive production of material:.
   - Improved environmental aspect of substation building and carbon savings will be achieved through reduced use of carbon materials, reduced use of copper, reduced use of oil and gas filled CT/VTs, and reduced number of site visits during commissioning and operation.
   - Substation footprint reduction in new substations (reduced substation building size and cost) and in existing substation (providing opportunities for expansion within the same footprint).

iii. Carbon and financial benefits for customers will be realised with CAPEX and OPEX benefits including:
   - Reduction in overall substation construction, commissioning and lifetime costs (~10%).
   - Reduction in modernisation related outage constraints as future replacement of protection will be non-disruptive. Thus mitigating risks of customer loss of supply, energy not supplied (ENS) penalty costs and replacement of renewables with thermal generation.
   - Fault location and characterisation, and adaptive protection will improve performance by minimising the number and duration of unplanned outages and will achieve operational savings through improved decision support.

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/ to the electricity Distribution 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; and
iv. The expected proportion of the benefits which will accrue to the electricity Transmission System/to the electricity Distribution System as opposed to other parts of the energy supply chain.

Sub-criterion v (the internal systems, procedures and processes used by the Network Licensee to identify Project Participants and Project ideas) should be covered in the 'Project Partners and external resourcing/funding' section below.

i. The scope and deliverables of FITNESS are aligned with SPEN's Transmission Innovation Strategy Review (2014) for implementation experience of IEC61850 based digital solutions for improving standardization and interoperability, increasing network capacity, improved asset management, addressing operational accuracy, reliability and round-trip latency required for business-as-usual implementation. The project will demonstrate the implementation of closed-loop fast-acting protection and control in the grid, and while it addresses a direct TOs responsibility in this area, the technical capability generated will positively impact GB SOs and DNOs.

ii. The total cost estimated for this project is £10m. Initial stakeholder engagement suggests there will be contributions from potential project partners in the order of £0.8m. The nature of the project, which will deploy novel substation protection and automation solutions not previously used on the GB system coupled with plans to use the system initially for demonstration with comparative analysis against conventional solution, but after satisfactory service, with operational control, will provide construction, engineers, planners and operators with confidence in the new systems' allowing them to be more quickly deployed in a 'BaU' context and reduce costs and risks associated with digital substation automation solutions.

iii. SPEN will adhere to SPT procurement obligations and follow competitive selection criteria during procurement to ensure best value for customers.

iv. The CAPEX benefits estimated by initial supplier engagement is ~10% per bay by implementation of digital technologies in new builds and refurbishments. The successful integration with BaU and knowledge captured will reflect cost benefits in the RIIO T2 period for all TOs. Similar savings can also be potentially achieved in SPEN's RIIO ED1 as learning outcomes can be applied to the distribution network as well.

The OPEX benefits will be achieved by proving through this project that protection modernisation can be carried out in service without planned outages. Hot standby units can be used for a period while repair is carried out without a need for an urgent dispatch. Reduced requirement of planned outages will reduce associated risks of constraint costs and Energy Not Supplied (ENS) penalty payments. Enabling secure remote access to the IEDs installed in a substation, enhanced information management and automation solutions will also add to the OPEX savings.

CAPEX and OPEX benefits will be evaluated and described in detail in the final submission.

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.

i. The project FITNESS will generate the following generic learning outcomes through comparative analysis and interoperability field tests in a live transmission substation environment:
   - For the Transmission Owner (TO) and the Offshore Transmission Owner (OFTO), as reduced substation footprint, better control and adaptive protection and accelerated substation secondary side modernisation with reduced outage requirements for improved network capacity, all of the above required for high renewables penetration and accelerated asset replacement strategy.
   - For the Transmission System Operator (TSO), enhanced information management and intelligent reports to improve operator response in storm conditions. The project facilitates implementation of the approaches studied in the Smart Transmission Zone NIA project by SPEN.
   - For the Distribution Network Owner (DNO), establish infrastructure for the future effective integration new Active Network Management tools to increase the penetration and utilisation of renewable and local energy sources, such as the SPEN Manweb NIA project on Angle Constrained Active Network Management and digital substation NIA project (SSE). FITNESS will also establish the potential future TSO requirements for the connected DSO.

ii. SPEN will endeavour to include GB TOs, OFTOs, DNOs and SOs in the project advisory board and/or as potential partners to influence the development of digital intelligent substation concept and applications. Involvement of suppliers as project partners will allow learning generated through this project to influence the R&D portfolio of various suppliers and accelerate future innovation in this area. Future products and applications from suppliers for digital substation automation solutions should be in line with network operators' interoperability and scalability needs.

Additionally, SPEN will use established arrangements for knowledge capture from previous NIA and NIC projects to support knowledge dissemination during the execution of the project. SPEN has successfully demonstrated such methods through its ongoing NIC project VISOR. Key learning outcomes and reports will be published in a project dedicated website and SPEN's innovation webpage http://www.spenergynetworks.co.uk/pages/innovation.asp.
A detailed knowledge dissemination approach will be a part of the full submission.

iii. SPEN conforms to the default IPR arrangements set out in NIC governance document.

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 a part of this NIC project will adhere to default IPR arrangements. Project partners and suppliers will comply with the default IPR arrangements as a part of the selection criteria. Any deviations, if identified, during the proposal development will be highlighted in the full submission.

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

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

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.

i. The overall objective of the Project is to provide confidence in novel transducers, substation infrastructure (using IEC 61850-9-2) and integration into information management and control processes. Both technical confidence and practical assessment of the business case for the change of approach are required.

Elements of the project that are globally innovative are as follows:

- Optical Voltage Transducers.
- Phasor-based, wide area control in general is still in its infancy, and the project includes its novel applications and implementation in an IEC 61850-9-2 environment.
- Novel integrated disturbance analysis using Phasor Measuring Unit (PMU) and fault characterisation.

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)

- Co-ordinated substation-wide presentation of harmonics.
- Phasor-based topology and linear state estimation, integrated with Energy Management System (EMS).
- Real-time fault classification, integrated with WAMS-based disturbance recording.
- Distributed sensor technology compatible with IEC 61850.

Elements that innovative in a live GB Transmission environment:

- Integrated digital substation solution using IEC 61850-9-2 Process bus, Merging Units and IEDs.
- Prove and test performance for NCIT-conventional instrumentation combination for protection solutions.
- Advanced Protection functions using IEC61850-9-2 demonstrated in a live substation in parallel with conventional solution (building confidence), leading to live operation
- Hot standby solution for IEDs.
- Co-ordinated substation and central situational awareness.
- Fault location and feature extraction as automated centralised function.

ii. The commercial availability of the products and systems is not a mass market solution as IEC61850-9-2 is not yet widely utilised in standard practices. The risks involved in deploying such a solution and current inability to quantify perceived benefits and assess performance, necessitates a demonstration project to prove the business case before integration into BaU. For all benefit cases, there is a need to have experience in the GB grid to assess the benefits in the GB environment, as practices and economics can vary significantly from country to country.

iii. The 'bridge' between developing and implementing this new technology is well known to be an obstacle to deployment in the utility industry throughout the world. Demonstration projects like FITNESS, well designed, with clear goals and outcomes are essential to building the confidence that network licensees require in order to place the reliability of the network and customer supplies on this technology.

The reliability of the protection and control system is of paramount importance, and without a confidence base at least approaching that of the convention solution, deployment of non-conventional technology and innovative automation solutions is likely to be slow and piecemeal. Comparative analysis of these methods under live transmission operational conditions will be key learning outcome of FITNESS.

Parallel deployment of conventional and non-conventional technology adds an expense to a bay refurbishment that is not justified under BaU, where lowest-cost options must be deployed. Parallel deployment is an important risk mitigation as part of the live deployment. Structured analysis of technical and operational risks and performance is an integral part of this project, and this will be built into the full submission.

Project Partners and external resourcing/funding

The Funding Licensee should provide a description of the internal systems, procedures and processes used by the Funding Licensee to identify Project Participants and Project ideas.

The Licensee should provide details of any Project Partners, External Funders or Non-Network Licensees 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.

SPEN has carried out extensive internal and external stakeholder engagement with other TOs (UK and worldwide), SOs and with multiple vendors and has received extremely positive response.

Internal stakeholder engagement within SPEN's innovation, network planning and regulation group concluded FITNESS will pursue real benefits for both TOs and DNOs. External stakeholder engagement with TOs in the UK, Brazil and France generated industry-wide interest in the project's potential learning outcomes. SPEN will continue to engage with multiple vendors to ensure value for money for UK customers. Vendors are being assessed through various stages of partner selection based on their compliance with project scope, requirements, costs, responsiveness and resource availability. A detailed partner selection procedure will be a part of the full submission.

The project was selected based on its following merits:

- Compliance with business innovation strategy.
- Compliance with "Standards for Smart Grids" published by CEN/CENELEC/ETSI Joint Working Group. http://www.etsi.org/WebSite/document/Report_CENCLCETSI_Standards_Smart%20Grids.pdf
- FITNESS aims to demonstrate in a **live substation environment** learning outcomes building upon the following NIA and NIC projects:
    - AS3 (NGET)
    - Digital Substation (separate projects NGET & SSE)
    - Distributed Photonic Grid Instrumentation (SPEN and SSE)
    - Protection Settings to Cater for the Evolving Transmission Network (SPEN)
    - IEC61850 Interoperability (SPEN)
    - VISOR (SPEN, NGET, SSE)
    - Smart Transmission Zone (SPEN)
    - Angle Constrained Active Management (SP Manweb)

SPEN has also engaged with UK SMEs to support demonstration of innovative solutions developed through the NIA in this project.

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 identified.

Customer impact

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

No direct interaction with customers is required, as all work is carried out within SPEN sites, and no outages are required beyond those planned already for BaU substation work. The live link trial of the new process bus concept will only be carried out after building sufficient level of confidence through the demonstration project and should not result in any supply interruptions due to failure of equipment and/or design concept.

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 and Gas NIC). 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
Following paragraphs are quoted from SPEN's transmission innovation strategy review (2014): **Interoperability**: The variety of new technologies deployed on the network will require to be interoperable such that new solutions can be readily integrated, for example through the application of technology standards such as IEC61850. We will work with the wider industry nationally and internationally to develop open-access standards. Reliable and secure communication systems will also be required to transfer data across the network combined with IT systems that can effectively manage the new data that is generated. This will require a significant extension of our communications systems using internal and external services to achieve the necessary coverage. **Intelligence:** As a result of the improved visibility and control of the network, active management of generation output around network constraints will improve the time required to connect new demand and generation. Wide area monitoring combined with real time asset ratings, will ensure that maximum capacity is utilised before reinforcement is required. Processing of network data will also inform designers of when reinforcement is required and inform the deployment of appropriate, cost effective, solutions.

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