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).[1] 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)		
Eastern Power Networks plc, London Power Networks plc, South Eastern Power Networks plc		
Network Licensee Project Partners		
The University of Strathclyde, specifically the Power Networks Demonstration Centre (PNDC), Western Power Distribution (WPD), Cisco		
Funding Licensee area(s)		
Eastern Power Networks plc, London Power Networks plc, South Eastern Power Networks plc		
Project Title		
Constellation		
Project Summary		
A key challenge to the achievement of the UK's ambitious Clean Growth Strategy[2] is that the existing electricity network infrastructure, which is critical to the delivery of an integrated, co-ordinated energy system, is continually developed from the current passive arrangement to the required smartness level. Today's network is not currently equipped to support the optimal real-time decision-making that enables efficient and cost-effective operation of the increasingly renewable-focused electricity distribution system. This project will develop and trial an innovative 'distributed intelligence' functionality to increase autonomy and resilience for existing and future DNO substations, enabling smart decision making through a decentralised and digitalised approach. The digital solution will cater for the implementation of the existing substation functionalities as well as future requirements; all this being open, flexible, future-proofed, software-based and upgradeable. This is expected to reduce the need for reinforcement or replacement of primary infrastructure as the nature of supply and demand changes by increasing operational flexibility and capacity. Complementary to the Future Power System Architecture (FPSA) project[3], "Constellation" moves away from static passive assets that are rooted in fixed hardware and network configurations to a dynamic flexible software-based solution; changing and adapting with the world around it, enhancing operational efficiency and enabling more low carbon demand and generation at reduced cost to customers.		
Estimated Start Date	**Estimated End Date**	
1st April 2020	31st March 2024	
Estimated Project funding		

[1] https://www.ofgem.gov.uk/publications-and-updates/version-30-network-innovation-competition-governance-documents All capitalised terms used in this document have the meaning given to them in the respective NIC Governance Document.

The Licensee must provide an approximate figure of the total cost of the project and the amount of NIC funding for which it is applying.

Total Cost of Project **(If Cross Industry Project provide cost split in Cross Industry section)**	£10m	**NIC funding requested**	£8.2m
Is the Technology Readiness Level (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.

The UK's ambitious Clean Growth Strategy drives the need for a significant acceleration in the pace of decarbonisation in order to meet the fourth and fifth carbon budgets (covering the periods 2023-2027 and 2028-2032 respectively). The energy sector sits at the heart of this decarbonisation plan and the industry must ensure that any initiatives to reduce emissions remain technologically innovative, commercially competitive and scalable for a GB-wide rollout.
A barrier to the aforementioned is the traditional topology of GB electricity network infrastructure and the top-down principles of network operation. While multiple smart functionalities are being embedded in the Distribution Management System (DMS) to support the increasing volume of smart dynamic energy resources connecting to the network, substations remain largely unchanged and continue to operate on conventional passive principles coupled with traditional vendor locked-in solutions. Currently, this means the tens of thousands of distribution substations will need to rely on the availability of robust communication links to the control centre for the necessary additional real time decision-making and control demands of the network. There are two key challenges to overcoming these issues: firstly, the time it will take (estimated at 10-20 years) for provisioning all the substations with communication links to the control centre; and secondly, the significantly higher costs (totex) to install and maintain high quality communication links (resilient, high bandwidth, low latency) for the scenario with only centralised control.
It is evident that a step change is required in the ways substations are designed, monitored, controlled and operated in order to best accommodate the developments in consumer and stakeholder expectations whilst also ensuring the quality and security of supply.
Future requirements on electricity networks from low carbon technologies are likely to place greater expectations on network performance (such as the need to cope with reverse power flows and adaptive protection), specifically considering the connection of low carbon energy resources (such as wind and solar farms), storage of electricity, and new demand (such as EV charging and heating requirements). Key to coping with these interdependent future requirements is the ability to accurately and reliably understand and act upon detailed performance characteristics of specific parts of the network, depending on external influences, quickly and precisely, and it is this where high quality data and timely decision making is critical.
At present, nothing has addressed these increasing requirements of substations, specifically in relation to the need for a greater level of whole system integration and automation by transitioning substations from passive assets towards being active and autonomous assets.

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.

UK Power Networks, in collaboration with our project partners, will design, develop and demonstrate innovative distributed intelligence functionality to increase autonomy and resilience of the future grid, primary and secondary substations, enabling smart decision making through a decentralised and digitalised approach. This includes the delivery of an open solution to enable new entrants to enter the market at a lower cost through the removal of vendor lock-in barriers. Furthermore, we plan to employ methodologies from the IT "DevOps"[4] world into utility development to drive down costs and time to deployment, further enhancing the potential for innovation.
The project will build upon and bring forward the learnings from research and development carried out in previous NIA and NIC projects within this domain (including SPEN's FITNESS, WPD's OpenLV and UK Power Networks' Unified Protection project), and demonstrate the implementation of the solution in a live substation environment. The project aims to ensure

Method(s) continued

that the delivered solution is replicable and relevant to DNOs throughout GB; this will be detailed in the dissemination plan, provided in support of the FSP.

The project will be focused around three phases:

Phase 1: Technical design of distributed intelligence architecture
We will create the core open solution onto which the critical functionalities will be built together with the enabling foundations for the "app" style functionalities discussed in phase 3.

The architecture design will include:
(a) Policy and Logic, specifically, the overarching top-down cascade of operational rules and parameters and their permissible variation at the localised asset level;
(b) Communications, specifically, the ability to undertake two-way interactions with specific assets or groups of assets within and connected to the network in a timely and operationally value adding way (for example, responding to alarms, not simply exchanging data); and
(c) Data, specifically, the outputs of appropriate measurements at the right resolution made at a local level in relation to network performance and operation, analysed and abridged locally to enable the communication of reduced but more focused metrics to the centralised systems.

The above design work will utilise "DevOps" best practice methods that are already well established in the IT world, applying them to the operational world, aligning to agile development and decreasing time to deployment.

Phase 2: Technical development and demonstration of the new distributed intelligence functionality
The first core deliverable of this phase will prove-out the design from phase one both off-network and on-network to verify the quality, functionality and security. It will take the form of centralised logic and policy being cascaded from the central control system, as stated in phase 1 point (a), coupled with distributed compute logic at grid, primary and secondary substation levels.

The second core deliverable of this phase will be to trial and demonstrate the distributed intelligence elements. Firstly in a safe environment by installing and testing it at PNDC, which will enable the acceleration of development, de-risking of the solution and validating the functionality. Secondly, these trials will then be verified in a live operational environment in UK Power Networks' distribution network at multiple substations. This will inform the practicalities of retrofitting in existing locations, prove the horizontal integration between substations and vertical integration with existing SCADA, and demonstrate the distributed intelligence platform at TRL 8. The basic functionalities will be developed for the visibility and normal operation of the substation, including protection, automation, optimisation and remote control, building on capabilities that have arisen from other projects such as Active Network Management (ANM), Active Response, Automated Power Restoration System (APRS), and LV Monitoring.

Phase 3: Technical development and demonstration of "app" style software solutions in preparation for commercial deployment
The final phase will centre on the development of additional advanced functionalities not currently available within the core substation architecture, which can be installed on the new architecture. This is intended to enable participation from a wider selection of potential suppliers than is currently available in a relatively closed and slow to develop market by lowering the barriers to entry, having a software focus, and reducing costs through use of the latest proven DevOps delivery methods.

A competition will be launched for additional functionalities, which will be developed by Small and Medium Enterprises (SMEs) and will be validated and demonstrated in PNDC. This competition will demonstrate the radical move from hardware solutions to software solutions in an open sourcing environment. It must be noted that an essential aspect of this project will be consideration of cyber security throughout all phases.

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. Non RIIO-Network Licensees should indicate potential bid costs expenses

The estimated total project cost of £10m is based on delivering the core activities embedded within our three project phases, as follows:

Phase 1: Design of distributed intelligence architecture £3.1m
Across Licensee partners (UK Power Networks and WPD) £1.22m covering Asset Management, Network Operations, Communications Infrastructure and Cyber Security technical design; Legal and Procurement Support; Project Management.

Included within the £3.1m for phase 1, the non-RIIO Licensee content is estimated as being: £1m for algorithm definition and design, £850k for architecture design, £30k for independent technical support.

Phase 2: Development and demonstration of the new distributed intelligence platform £5m
Across Licensee partners (UK Power Networks and WPD) £2.07m covering Asset Management, Network Operations, Communications Infrastructure and Cyber Security technical development and verification; Legal and Procurement Support; Project Management.

Included within the £5m for phase 2, the non-RIIO Licensee content is estimated as being: £1m for algorithm development, testing and verification, £1.65m for architecture development, construction, testing and verification, £280k for off-network testing and verification.

Phase 3: Development and demonstration of "app" style software solutions £1.9m
Across Licensee partners (UK Power Networks and WPD) £1.32m covering Asset Management, Network Operations and Cyber Security technical support for software development; Legal and Procurement Support; Project Management.

Included within the £1.9m for phase 3, the non-RIIO Licensee content is estimated as being: £280k for software development support and off-network testing and verification, £300k for supporting app development that arises from the development competition.

These estimates are based on the combined UK Power Networks' and partners' experience in delivering similar projects, together with people costs based on current rates and estimated work volume, with material costs based on current unit costs and estimated volumes.
At this early idea development stage, the project partners aim to contribute as follows:

UK Power Networks	10% of net NIC funding contribution
WPD	10% of WPD project costs
Cisco	25% of Cisco project costs
PNDC	10% of PNDC project costs

It is expected that an additional organisation will be contracted into the project to undertake design and development of the algorithm, as either a supplier or a partner, with an appropriate funding contribution.
The contributions will include in-kind provision of time, resources and data, ensuring that the project can proceed at a lower cost than if it was delivered commercially and allowing the project to utilise existing Intellectual Property (IP) and data held by the partners.

Which specific requirements does 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 and have the potential to deliver net financial benefits to existing and/or future customers in the relevant sector?

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.

This project has been developed with consideration of The Carbon Plan[5], specifically with reference to developments thereof, such as no new build fossil fuel heating in homes from 2025 and supporting the shaving off of demand peaks. We believe the outcomes of the project will support The Carbon Plan through accelerating the development of the low carbon energy sector and furthermore delivering net financial benefits to existing and future customers by:

(a) Directly impacting the electricity network through reducing the network investment required to facilitate the DSO transition. The architecture and functionality produced as an outcome of the project will enable more efficient utilisation of existing network assets, which will support reducing network costs for customers.

(b) Increasing the autonomy of distribution networks at more localised levels, which enables greater visibility and intelligent integrated control of the network. This will ultimately further enable the additional network capacity required for the large-scale penetration of renewable technologies, both in supply and demand, by offering the flexibility and operability necessary to handle the volume and volatility of such connections.

(c) Integrating multiple innovative functions and applications in an open and interoperable platform aims to overcome vendor 'lock-in'. It has been observed that vendor lock-in creates barriers to innovative newcomers and presents a cost risk to consumers arising from reduction in competition and restricted maintenance options. By enabling an open platform, it will be possible to explore the deployment of innovative applications from numerous new app developers in a controlled and managed way, thereby improving supplier/partner choice to the benefit of network operators and, ultimately, customers.

(d) Demonstrating digitalised local control within existing substations, we will show that existing substations are sufficient to support the energy transition to DSO, based on current forecasts, building confidence that any increase in the level of capital investment required in the future is minimised through this transition. We will demonstrate the value in the vertical and horizontal integration of substations, moving from isolated grid, primary and secondary substations to those that communicate autonomously between themselves, operating the local network area within permissible bounds without significant central intervention, thereby opening up network capacity through more flexible use of existing assets. Control is assured through the cascade of policy and logic that enables substations to operate within and between themselves without the need to route decision making through the Control Centre, but still sends locally analysed essential data and critical decision requests back as appropriate. This therefore decreases:

- capital investment risk of network reinforcement; and
- the related costs of connection and operation of renewable technology and DER

that may otherwise have resulted in increased cost to operators and therefore customers. Given the increasing prevalence of such connections, it is an appropriate time to start this work now in order to maintain the current trend of performance gains as we transition to increasingly dynamic requirements from networks.

(e) Provisioning of smarter operation and maintenance models, in the unlikely event of unplanned shutdowns, the localised control should allow consumers' power to be restored in a lower cost, timelier and more efficient manner. The creation of these models and similarly innovative advanced functionalities for existing substations will allow reduced costs for operators and customers by:

- enabling the real time environmental status and overall condition reporting of assets in place of traditional and costly physical inspection regimes; and
- enhancing the security of sites through live remote monitoring rather than relying on post-incident reporting.

A detailed calculation of all benefits will be provided at FSP stage.

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

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

With regard to offering a high level of value for customer money, the project partners were chosen after careful consideration of their industry reputation, experience and involvement in previous related projects, as will the additional competitively identified partner/supplier.

Furthermore, we will select trial sites based on their suitability for ensuring the solution produced will be replicable and scalable to all GB DNOs. We believe undertaking trials on a maximum of three vertical layers of the network (i.e. grid, primary, and secondary substations) and the associated horizontal links offers sufficient scale for the outcomes to demonstrate the value of the innovation and the learnings thereof without excessive costs. Conducting the development and trials collaboratively in one demonstration project minimises the risk of spending on unsuitable solutions across a multitude of unlinked projects that are not future-proof or relevant to all GB network operators.

To further minimise this risk, the project will look to build upon existing relevant innovation projects such as Unified Protection, FITNESS, OpenLV and the research outputs from PNDC's digital substation work programme. Integration with and consideration of other projects such as ANM, Active Response, APRS, and LV Monitoring ensures that this is a holistic and coordinated view of the future network and a major step towards the whole system optimisation.

This project will demonstrate the unification of the existing and new solutions and approach towards a wholly integrated and optimised system, both within and between DSOs, and the transmission level.

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 will be disseminated.

Specifically, the project is expected to generate the following new learning of importance to licensees:

- A robust and scalable design and infrastructure of distributed intelligence operation that coordinates with existing centralised control systems;
- Optimised logic for horizontal and vertical integration of the DNO network;
- A developed software framework for distributed intelligence;
- A means of removing vendor "lock-in" constraints to lower the barriers of entry for SMEs;
- A smart, remote maintenance model; and
- A means of managing the shift towards a wholly integrated system view, embedding this within the existing substation environment.

UK Power Networks, the project lead, working in collaboration with WPD bring with them extensive experience in the management, visualisation and sharing of rich datasets across seven of the fourteen DNO areas. In addition, it is intended that the project partners, together with expert academic and/or specialist consultants, will analyse and report on the findings of the project, the applicability to the wider electricity system, and support the development of commercial business cases.

This learning will be disseminated to licensees through existing channels including bi-annual reports, the LCNI conference/events, ENA working groups, stakeholder groups and project closeout events. A detailed dissemination plan will be included as part of the FSP, and this will be a key work package for the project to ensure learning is shared.

Does the Project conform to the default Intellectual Property Rights (IPR) arrangements set out in the NIC Governance Document?	YES ☒	NO ☐

By selecting NO, the Licensee is indicating that it 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 IPR arrangements.

Not applicable

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.

This project will be GB's first demonstration of autonomous, digitalised, local substation control utilising existing network infrastructure, shifting from a series of passive assets to active assets situated between already active network control and increasingly active supply and demand.

Due to the solution needing to be replicable and scalable for all GB network operators, only a collaborative approach and demonstration is capable of successfully achieving this. Furthermore, we believe that including partners from the private sector and independent academic experience (Cisco and PNDC respectively) ensures that the full breadth of knowledge and skills is made available in the delivery of the project outcomes.

The outcomes of the project could not be achieved through business as usual as the commercial options currently available lead to vendor "lock-in", and the optimal open solution is yet to be identified through mature demonstration. This presents too high a risk for business as usual investment for a certain solution/architecture that may not be feasible or scalable and replicable to network operators throughout GB. Investing in the incorrect solution without suitable research and development would not only present a cost risk to operators, but also to GB customers.

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

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 project arose from UK Power Networks' process for sourcing new project ideas, including the participation in the ENA's joint NIC call and internal horizon scanning. The idea for Constellation was generated from horizon scanning, specifically from a joint research project between UK Power Networks, the University of Strathclyde (via PNDC) and Cisco in this domain. UK Power Networks is the lead party for the project and will lead the development and demonstration of the platform, collaborating with WPD, the University of Strathclyde, Cisco and a (later procured) algorithm developer.

UK Power Networks and WPD combined cover London, the East and South East, the Midlands, South West and South Wales. The partnership is based on WPD's significant previous experience in architecture development relevant to local substations for LV networks and successful delivery of previous NIC/NIA projects. The DNO partners therefore have extensive experience in network projects, along with unique experience of differing network infrastructure environments.

The University of Strathclyde (specifically PNDC) has a significant track record of de-risking and validating smart grid, industry scale solutions at their unique 11kV test facility. Cisco brings a wealth of proven expertise in the technical delivery of high quality connected solutions across a breadth of technology sectors, industries and geographical locations.

This project ISP is the product of a digital substation workshop aimed at development of NIC proposal ideas between PNDC, its current members and Cisco.

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.

No derogations or exemptions are expected at this stage.

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).
It is not anticipated that this project will involve any direct customer impact or interaction with them or their premises.
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.
Not applicable.

Are there any further details the Licensee considers would support its submission?
In addition to the above, Constellation also responds to the challenge put forward by large-scale energy systems initiatives such as the Industrial Strategy Challenge Fund (ISCF), "Prospering from the Energy Revolution". We believe this initiative, with it being geared towards attracting interest from unregulated businesses to develop new technology, complements the NIC funding on offer for regulated DNO businesses. By 2022, the ISCF initiative is set to deliver replicable, scalable, and large scale energy systems demonstrators that will include new business models that intelligently link supply, storage and demand patterns across power, heating and transport. It therefore follows that, by 2022, it would be highly desirable that network operators throughout GB ensure that they are taking a co-ordinated, integrated approach to maintain efficiency, control and visibility of the network at the distribution level. Completing by 2024, and with outcomes visible as the phases of the project progress, the Constellation project will provide DNOs with the critical solution necessary to achieve this, supporting the future smart DSO strategy and ensuring GB's energy system is future-proofed for a distributed, localised energy system approach. References [2]https://www.gov.uk/government/publications/clean-growth-strategy [3] Functions C5, D1, E1, E5, E6, E7, F1 and F3 on pages 20 and 21 of https://es.catapult.org.uk/wp-content/uploads/2017/08/FPSA2-Synthesis-Report-WEB_Locked-ESC-version-1.pdf [4]https://www.cisco.com/c/m/en_us/network-intelligence/service-provider/digital-transformation/adopting-devops-culture.html [5]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47614/3751-carbon-plan-executive-summary-dec-2011.pdf

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