Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Jan 2026

Project Reference Number

NIA_UKPN0117

Project Registration

Project Title

Network Exchanger Transformers NExT

Project Reference Number

NIA_UKPN0117

Project Licensee(s)

UK Power Networks

Project Start

February 2026

Project Duration

1 year and 4 months

Nominated Project Contact(s)

Andrew.burton@ukpowernetworks.co.uk

Project Budget

£531,091.00

Summary

The importance of voltage stability is increasing on the distribution network due to an increase in connections of low carbon technologies (LCTs). LCTs are reliant on stable voltages, and there is a risk that voltage fluctuations can cause equipment such as electric vehicle (EV) chargers to trip or not be able to charge effectively. To manage these fluctuations investigations, and in some instances, network reinforcement is required. The Network Exchanger Transformers (NExT) project will trial innovative power electronic devices retrofitted to existing network high voltage (HV)/low voltage (LV) transformers. These upgrades will make the transformers smart, allowing them to automatically manage voltage changes and improve how efficiently the network operates by controlling active and reactive power across phases.

Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

Problem Being Solved

Voltage constraints on the distribution network are increasing due to an increase in LCTs, such as EVs and rooftop solar, connecting to the network. These LCTs depend on stable voltage and are highly sensitive to voltage fluctuations. As a result, voltage enquiries have risen, with issues such as EV chargers tripping or failing to charge effectively. To manage these constraints investigations, and in some instances network reinforcement, is required.

On the LV network, voltage is typically regulated using on-load tap changers (OLTC). These devices adjust the voltage by changing the transformer tap position to modify the voltage on all three phases of the LV network. While this approach can resolve a voltage issue on a specific feeder, it can inadvertently introduce voltage issues on adjacent phases and feeders, as the adjustment is applied universally across all phases. Also, the extent of the voltage change may lead to either excessive or insufficient voltage levels, potentially causing further complications elsewhere on those feeders. It is important to note that OLTC operations are inherently

physical and mechanical, meaning the equipment is susceptible to wear and tear over time, which can affect reliability and increase maintenance requirements.

Power factor also plays a significant role in network capacity; a lower power factor (more reactive power) increases the thermal loading on infrastructure which also has an impact on the life expectancy of equipment. By correcting (raising) the power factor, this enables more active power to be delivered, thus increasing capacity, improving power quality and reducing thermal loading that could increase the life of equipment.

Additionally, when local generation exceeds load on a phase, rooftop solar output is curtailed to maintain network stability. This not only results in lost revenue for customers but also drives their dissatisfaction.

Method(s)

The project will trial innovative power electronic devices known as a Network Exchanger, developed by Third Equation. These devices are retrofitted to existing transformers in situ, making them smart assets capable of active and reactive power control across phases. This dynamic functionality enables voltage management and correction of the issues identified above.

The solution is installed in series on to each phase of the LV terminals of the secondary transformer. It will enable the control of loads across the three LV phases which can reduce constraints on individual phases, through reactive and active power transfers. Key functionalities include:

· Voltage regulation (real power): Maintains voltage within ±1V of a setpoint, independently on each phase, responding instantly to manage dynamic load changes

· Phase balancing: Redistributes loads across phases to mitigate imbalances and increase grid capacity. Also supports efficient use of PV-generated power across all phases

· Power factor correction: Produces reactive power downstream to reduce transformer current and heat generation, improving efficiency and extending transformer life

· Harmonics reduction: Minimises waveform distortions in the electrical signal, enhancing power quality and reducing energy losses, and increases the efficiency of connected devices

This project will test and collect data to validate that the solution can:

· increase grid capacity

· improve power quality

· allow more connections on the LV network

· manage the voltage on individual phases of the LV network at the secondary transformer

· increase the life of existing assets and improving the service to customers.

Compared to traditional solutions such as OLTC, off load tap changers and the AmpX smart transformer, which all adjust the voltage on all three phases, the NEx solution offers independent phase control and active line drop compensation.

Measurement Quality Statement

All data used within this project is for the purposes described above, and therefore quality will be measured on this basis. The project

will follow all data quality rules, logging, and prioritising issues as they arise in line with the approved methodology set out in our Enterprise Data Management Policy, which forms part of the UK Power Networks Integrated Management System.

Data quality will be measured across five dimensions where applicable:

- Accuracy
- Completeness
- Consistency
- Validity
- Uniqueness.

Data quality rules for each of the appropriate data quality dimensions above will be set by the project, measuring them closely on a regular basis to identify quality issues.

Data Quality Statement:

Data quality issues will be logged in a central location and prioritised using an approved matrix which combines the importance of the issue, and the amount of data affected, this gives an indication of the issue's impact on the project and wider business, considering factors such as:

- The impact on the project outcomes and the performance evaluation of the solution
- The impact on the health and safety of the public and employees
- Whether it may result in a breach of our licence conditions or relevant regulations
- The impact on UK Power Networks' reputation
- The impact on our operations and efficiency
- The financial impact, including project delays and charges from external service providers.

The project will then seek support for resolving the issues in priority order. All data and background information will be stored centrally and securely in a project specific SharePoint folder or in our Enterprise Data Store if required by the wider business in accordance with data protection requirements.

Scope

The NExT project will assess the benefits of Third Equation's NEx technology by installing up to five units at selected distribution substations and trialling their performance.

Key activities within the scope include:

- Site selection: A desktop survey will identify candidate substations where transformer utilisation is suitable for the trial. Additional considerations include transformer capacity (300 kVA to 1 MVA), thermal ratings, residential/commercial mix, and ease of site access. Following this, site surveys will confirm space requirements and installation feasibility. Sites will be selected across UK Power Networks' Eastern Power Networks (EPN) and South Eastern Power Networks (SPN) licence areas.

- Manufacture and factory acceptance testing (FAT): Once the NEx devices are manufactured, all NEx devices will undergo FAT to verify compliance with technical specifications and operational safety standards before deployment. Additionally, specific engineering documentation will be put in place and signed off prior to installation.

· Training: Prior to installation training will be provided to Network Operations and Network Control teams responsible for the areas where Nex devices are installed, ensuring safe and effective operation.

· Installation: After successful FAT and training NEx units will be installed on standard transformers at selected sites.

· Operational trial: The trial will begin with a passive monitoring phase to establish baseline data, followed by active operation to assess the impact on voltage regulation, phase balancing, power factor correction, and harmonics reduction. This will include analysis of the data to make recommendations on the setpoints and to demonstrate the effects of the installation.

· Reporting and recommendations: A final report will summarise trial outcomes, lessons learned, and recommendations for business-as-usual (BAU) deployment. It will also consider applicability to other transformer types and integration requirements.

If the solution does not meet performance expectations, the NEx devices will be decommissioned and removed at the end of the project.

Objective(s)

· Identify transformer types that can be retrofitted with the NEx and compile a list of those requiring significant adaption.

· Measure and evaluate the performance of the NEx under real network conditions.

· Identify the installation requirements and associated costs for large-scale rollout of the NEx across the network.

· Work with the UK Power Networks' subject matter experts to identify the best opportunities for performance gains across the network and assess any additional functions that could be incorporated into NEx to further enhance distribution network efficiency

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The NExT project is not expected to have any adverse impacts on consumers in vulnerable situations compared to other customers. The trial involves retrofitting NEx devices at selected substations and does not require any changes to customer premises, equipment, or tariffs. Therefore, there are no anticipated technical, financial, or wellbeing-related distributional impacts for vulnerable consumers.

The project may deliver indirect benefits to all customers, including those in vulnerable situations, by improving power quality and reducing voltage-related issues.

Success Criteria

The success of the NExT project will be evaluated against the following measurable criteria:

· Voltage regulation: Test data confirms that voltage is controlled to the setpoints, reducing voltage spikes.

· Phase balancing: Thermal loading on the transformer is reduced and load is balanced across phases.

· Power factor correction: Power factor is improved to a target of 0.95 (subject to site conditions) on the transformer side of the NEx,

· Capacity increase: A measurable increase in network capacity

· Device reliability: NEx unit demonstrate 100% operational availability subject to network conditions

· Scalability and rollout: The NEx is proven to be suitable for a range of transformer types within UK Power Networks' licence areas, supporting scalability for future deployment

Project Partners and External Funding

This project will be delivered in partnership with Third Equation who are the manufacturer of the NEx.

The project will be NIA funded and is not receiving an external funding from either the project partner or any other sources.

Potential for New Learning

The project aims to generate learning on the application of power electronic devices for LV networks. The project will explore how voltage control, phase balancing and power factor correction can increase transformer capacity, improve power quality and provide stable voltages.

Key areas of expected learning include:

· Technical performance: Understanding the real-world effectiveness of NEx devices under varying network conditions

o Voltage regulation: the effect of controlling the flow of real power through the trimming transformer to increase or decrease the load voltage on each phase

o Phase balancing: the effect of taking power from the lightly loaded phases and supplying this to the higher loaded phase(s)

o Harmonics reduction: the effect on eliminating or reducing the harmonics of the harmonic content independently on each phase.

o Power factor correction: the effect of providing reactive current needed by the loads from after the trimming transformer to increase the capacity of the transformer

· Retrofit feasibility: Identifying which transformer types and substation configurations are most suitable for NEx installation

· Operational Integration: Insights into how NEx devices interact with existing network control systems and the operational processes required for safe and efficient deployment

The results and recommendations from the field trial will be recorded including performance data, and lessons learned and will be disseminated at industry conferences, and summarised in the relevant NIA report(s).

Scale of Project

The scale of the investment will enable the development, deployment, trial and assessment of a suitable number of NEx units that will provide valuable insights into installation requirements across a range of substation archetypes and the performance of voltage and phase balancing, harmonic reduction and power factor adjustment.

The scale of investment aligns with the potential benefits. If the project were of a smaller scale the ability to assess different substation archetypes and transformer models would be diminished and a reduction in trial sites would limit the ability to assess the NEx performance across differing network conditions. It provides representative learning on installation complexity, operational performance, and cost-benefit outcomes, enabling informed decisions on future deployment.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

Trial locations will be located within UK Power Networks' EPN and SPN licence areas. Exact locations for the trial sites will be selected during the project.

Revenue Allowed for the RIIO Settlement

No funding was provided within the current RIIO-ED2 settlement that will become surplus to requirements as a result of this project. The NEx if successful, will be another option in our toolbox to support voltage issues and reinforcement.

Indicative Total NIA Project Expenditure

The total expenditure that UK Power Networks expects to incur for this project is £531,091. 90% of this (£477,982) will be recovered from NIA expenditure, with the remaining 10% (£53,109) being contributed by UK Power Networks.

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

In designing this project, we have considered the impact that voltage fluctuations can have on LCT performance and customer experience, as well as the effect of individual phases of an LV transformer reaching capacity on new connecting customers.

Managing voltage fluctuations ensures that customers' LCTs are less likely to be affected by voltage fluctuations, which helps maintain their performance and provides a positive experience aiding the energy system transition.

Additionally, shifting load between phases allows more new customers to connect without delays caused by reinforcement requirements. If reinforcement is needed, it could slow down connections and negatively affect the experience of customers engaging with the energy transition.

How the Project has potential to benefit consumer in vulnerable situations:

Not applicable.

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

Not applicable.

Please provide a calculation of the expected benefits the Solution

The total benefits calculated across RIIO-ED2 and ED3 is £4.7m and further details and assumptions can be found below.

The expected benefits arise from optimising the reinforcement of at capacity transformers, where installation of a NEx can release capacity where there is phase imbalance, hence prolonging the useful life of the transformer.

The following assumptions have been made:

Base Cost

- Cost of upgrading a substation: £63k

Method Cost

- Unit cost of installed NEx: £30k
- Indicative deployment plan: install 24 NEx per year
- Method cost = unit cost installed NEx * quantity of NEx installed

Please provide an estimate of how replicable the Method is across GB

If this project's approach is successful, all GB DNOs could adopt the solution as part of their toolkit of solutions to support the management of network voltages and capacity.

Please provide an outline of the costs of rolling out the Method across GB.

The indicative costs of rolling this solution out per site is c. £30k.

An indicative cost of rolling this method out across GB scale are in the order of £4.3m annually based on the UK Power Networks rollout scale.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

☐ A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).

☐ A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)

☐ A specific novel operational practice directly related to the operation of the Network Licensees system

☐ A specific novel commercial arrangement

RIIO-2 Projects

☑ A specific piece of new equipment (including monitoring, control and communications systems and software)

☐ A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven

☐ A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)

☐ A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology

☐ A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution

☐ A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

The project aims to deploy and trial a power electronic device that can be retrofitted to existing transformers and operating them for independent phase voltage control, phase balancing, power factor correction and harmonics reduction in live network conditions. This learning will help other DNOs to assess solutions that defer reinforcement, improve power quality and release capacity on constrained LV feeders.

The work will also set out which transformer/substation typologies are most suitable for retrofit and provide an installation complexity RAG framework that others can adopt to screen candidate sites and plan delivery.

Other DNOs can also leverage the technical specification/user requirements produced by the project as a template for market engagement and supplier evaluation in other licence areas.

The project will also identify any other functions that could be added to NEx to further benefit distribution networks.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

n/a

Is the default IPR position being applied?

☑ Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

NExT's innovative technology has not been used before in this context and therefore will not result in any duplication. Whilst UK Power Networks' Stratus project investigated the development of smart transformers at secondary substations, NExT focuses on retrofitting a power electronic device on to existing secondary transformers, enabling smart functionality without replacement of the transformer. NExT also enables management of individual phases from the transformer giving the ability to transfer loads between phases, while the Stratus AmpX smart transformer was not capable of.

The NExT also enables management of phase voltage enabling a more stable voltage for the end customer. We are aware of other initiatives which are attempting to identify methodologies to identify how power electronic devices can be considered as part of network studies in place of reinforcement work, such as SP Energy Networks' D-Suite project (SIF Round 2 Beta Phase).

Therefore, the NExT project complements previous innovation work rather than duplicating it, delivering new technical insights and operational strategies that will inform future network flexibility and decarbonisation initiatives.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

While the D-Suite project is developing insights into power electronic devices, they are focused on established solutions, such as soft open points and smart transformers. The NExT project is not yet an established solution and offers alternative capabilities and benefits over solutions currently in use. once developed the NEx can be added the suite of tools offering a wider diversification of solutions.

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

The NEx is a first of its kind innovation solution that enables retrofitting power electronic devices to existing network transformers in situ, making the transformer smart, allowing network efficiencies through active and reactive power control across phases, dynamically managing voltages and removing the need for disruptive network reinforcement. This type of retrofit solution is new and has not been deployed or trialled anywhere in GB.

The project will generate new learning on the practicalities of retrofitting such devices to a diverse range of transformer types, including installation complexity, integration with existing systems, and real-world operational performance. The insights gained will inform future network management strategies.

Relevant Foreground IPR

The NExT project is expected to generate relevant foreground IPR in several key areas:

Retrofit Methodology and Technical Specifications

New knowledge and documentation will be created on how to retrofit NEx devices to a range of transformer types, including installation procedures, and integration requirements. This will include technical specifications and user requirements tailored for UK Power Networks and relevant for other DNOs.

Control Algorithms and Performance Data:

The project will develop and validate control algorithms for voltage regulation, phase balancing, power factor correction, and harmonics reduction in live network conditions. Trial results, and optimisation strategies arising from the trial will form part of the foreground IPR.

Operational Insights and Recommendations:

The field trial will produce new learning on operational practices, asset management, and network optimisation, which will be captured in reports and recommendations for BAU rollout.

The innovator, Third Equation, is bringing background IPR in the form of the existing NEx device and its proprietary technology. Use of the relevant foreground IPR generated in this project will require access to this background IPR.

Data Access Details

Any data gathered during the project such as trial data and analysis, technical feasibility notes, and use case documentation will be stored securely within UK Power Networks' internal systems.

Where appropriate, de-sensitised data and non-confidential findings will be made available to interested parties in alignment with our Data Sharing Policy. UK Power Networks recognises that Innovation projects may produce network and consumption data, and that this data may be useful to others. This may be shared with interested parties, whenever it is practicable and legal to do so, and it is in the interest of GB electricity customers. In accordance with the Innovation Data Sharing Policy, UK Power Networks aims to make available all non-personal, non-confidential-sensitive data on request, so that interested parties can benefit from this data.

To view UK Power Networks' Innovation Data Sharing Policy, please access it through our innovation microsite: https://innovation.ukpowernetworks.co.uk/

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

The project involves development and trial of novel network equipment that has not been previously deployed in GB. The technology is unproven at scale and its performance under real network conditions is unknown so it carries technical and operational risks.

These activities are not part of routine operations due to the low Technology Readiness Level (TRL) and the inherent risks associated with the project, given the unproven benefits. Therefore, NIA project funding is essential to advance the innovative aspects of the project to explore approaches to LV network management and manage the associated risks for its implementation.

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

The NExT project introduces a novel technology, the NEx, that has not been previously deployed or proven on GB electricity networks. As such, the project carries several risks that make it unsuitable for business-as-usual funding and necessitate support through the NIA:

Technical Risk

The NEx device offers advanced functionality such as independent phase-level voltage control, active/reactive power management, and harmonics reduction. These capabilities have not been validated under real-world operating conditions on UK Power Networks' infrastructure. There is uncertainty regarding performance, reliability, and interoperability with existing systems.

Operational Risk

Retrofitting NEx devices to existing transformers introduces potential challenges around installation complexity, site constraints, and integration with network control processes. These factors could impact operational safety and continuity if not thoroughly tested in a structured trial environment.

Commercial Risk

The cost-benefit case for large-scale deployment is currently unproven. Without trial data on installation costs, performance gains, and lifecycle benefits, there is a risk of inefficient investment if the technology does not deliver the expected outcomes.

Overall, the NIA support is crucial to manage the risks associated with the project's innovative and transformative objectives.

This project has been approved by a senior member of staff

☑ Yes