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

Nov 2022

Project Reference Number

NIA2_NGET0025

Project Registration

Project Title

Wide Area Control Framework

Project Reference Number

NIA2_NGET0025

Project Licensee(s)

National Grid Electricity Transmission

Project Start

January 2023

Project Duration

0 years and 10 months

Nominated Project Contact(s)

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Project Budget

£225,000.00

Summary

With the integration of renewable energy resources as part of the net-zero transition, electricity networks will experience a loss of inertia which is well documented. This situation makes the power systems more dynamic and time constants for mitigations are getting shorter. These decreased reaction times in operation require automated systems which can tackle the higher dynamics in the grid. Wide Area Monitoring, Protection, Automation and Control (WAMPAC) schemes are one key element in this context. Wider availability of synchronized phasor data increases the observability and awareness of higher system dynamics. The phasor data and power system modelling will be used to develop a roadmap and proof of concept for advanced WAMPAC systems including optimised automated network control enacting contingency measures for power system events.

Third Party Collaborators

Siemens

Nominated Contact Email Address(es)

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Problem Being Solved

One of the well documented key challenges of the energy system transition is the higher penetration of inverter-based resources and their impact on fault levels, inertia and hence system stability. Whilst system design and modelling are taking these challenges into account enhanced system awareness and monitoring are required to better understand actual system stability and validate modelling results. To address this, STCP 27-1 mandates all TOs to install synchronised system monitoring at their substations to improve the wider system observability by the end of the RIIO T2 period. Whilst some work has been carried out on enhanced system monitoring, the analysis of monitoring data and opportunities for wide area control systems to optimise system performance and prevent instability require further investigation.

Method(s)

To address the above problem this project will carry out research into current capabilities, tools and methods to deliver better system awareness and monitoring as well as wide area protection automation and control schemes. These WAMPAC schemes are typically known as Special Protection Schemes (SPS), System Integrity Protection Schemes (SIPS), Remedial Action Schemes (RAS) and are based on some level of system monitoring. Based on the findings a roadmap to achieve full automation and “autonomous” network operation will be developed.

The project will develop and calibrate a network model for a critical part of the NGET network and develop a proof of concept for a future WAMPAC scheme based on PMU and SCADA data. The proof of concept will study a range of system events and examine how new contingencies could be evaluated and deployed as part of a RAS.

Data Quality Statement (DQS):

- The project will be delivered under the NIA framework in line with OFGEM, ENA and NGET internal policy. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal Sharepoint platform ensuring access control, backup and version management. Relevant project documentation and reports will also be made available on the ENA Smarter Networks Portal and dissemination material will be shared with the relevant stakeholders.

Measurement Quality Statement (MQS):

- The methodology used in this project will be subject to our supplier’s own quality assurance regime which is ISO 9001 certified. Quality assurance processes and the source of data, measurement processes and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and will be made available for review.

In line with the ENA's ENIP document, the risk rating is scored Low (4).

TRL Steps = 1 (1 TRL step)

Cost = 1 (£225k)

Suppliers = 1 (1 supplier)

Data Assumption = 1 (defined assumptions and principles)

Scope

The scope of the project covers 4 work packages (WP) including literature research, building a state of the art, development of new WAMPAC strategies, proof of concept and concludes with the development of a roadmap and recommendations.

WP1 – State of the Art

This work package includes a review of the literature on WAMPAC concepts and implementations specifically where network modelling and monitoring data have been used to inform RAS. It also includes a review of current practise in GB and specifically existing infrastructure in terms of communications, cyber security requirements, current operational tripping schemes and the associated system architectures.

WP2 – Future requirements and objectives

Future WAMPAC objectives and requirements will be defined based on the anticipated evolution of the transmission network and the associated challenges. System observability and a range of contingencies will be studied to determine the design and required features of future WAMPAC systems. Based on the findings the transition from the current system to the future designed capability will be investigated and recommendations will be documented.

WP3 – Future WAMPAC proof of concept

To validate the concepts developed in the earlier WPs, a critical part of the NGET network will be modelled including its PMU data sources. The model will be validated and calibrated using historic SCADA and PMU data. The calibrated model will be used to define and simulate a range of system events to develop and evaluate the performance of automated remedial actions taken by the new WAMPAC scheme.

WP4 – Strategic Roadmap

The outcomes and learning from WP1 – 3 will be used to develop a strategic roadmap as a blueprint for delivery of advanced WAMPAC capability. The roadmap will reflect key design goals and the anticipated future system needs.

The learning from the project will be documented in the project reports and disseminated to stakeholders.

Objective(s)

The objective of this project is to develop new enhanced Wide Area Monitoring Protection Automation and Control systems based on phasor data and network modelling. These WAMPAC schemes will be designed to ensure that electricity networks can be operated at their maximum capacity and reduce constraints whilst keeping networks secure and stable under credible fault scenarios.

Consumer Vulnerability Impact Assessment

An assessment of distributional impacts (technical, financial and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a positive, negative or neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register.

This project has been assessed as having an overall positive impact on consumers in vulnerable situations. The assessment has identified that this project will look to reduce the costs for households over the long term through the positive impacts on constraint cost reduction, optimizing network investment and other value areas. The project is expected to support energy networks to deliver a stable and secure electricity network and reduce the overall cost of delivering the required network capacity. If these savings are achieved, the financial distributional impact of this project aligns with the simplest case discussed in OFGEM's Assessing the impact of economic regulation report. The report confirms that the savings as a percentage of household income are more significant for lower income deciles and therefore the achieved benefits will be particularly valuable to vulnerable consumers. The pricing structure for energy transmission will not be impacted, e.g., benefits delivered as part of this project can be passed on to all consumers including households using a prepayment meter.

Success Criteria

The success of this project can be measured based on the extent to which the objectives have been achieved, i.e. the successful delivery of reports, models, algorithms, designs and a clear roadmap for future WAMPAC systems that will facilitate the delivery of our net-zero target. The project will provide essential learning to the industry on future requirements for system monitoring, stability assessment and optimisation of contingencies following system events. The project is expected to deliver progress in terms of our ambition to work towards autonomous network operation.

Project Partners and External Funding

Not applicable

Potential for New Learning

This project has the potential to deliver significant new learning how improved system awareness generated from monitoring data can be assessed and processed in real time or close to real time to drive wide area protection, automation and control schemes. The learning will be embedded in the following outputs to network licensees:

- Overview of the current state of the art
- Specification for future requirements
- Case study based on new WAMPAC application to NGET network
- Roadmap for wider deployment of future WAMPAC systems based on PMU data and real time network modelling

The learning will be disseminated through the publication of the final project report and depending on opportunity through publication and presentation of research papers at conferences and through the ENA and CIGRE.

Scale of Project

The scale of the project includes a desktop study and a lab-based proof of concept of a new WAMPAC system. The new WAMPAC scheme will be based on a small area of the NGET network and will require the collection of PMU and SCADA data for calibration and validation purposes. A lab-based proof of concept will be carried out using network modelling tools to demonstrate the capability of the new WAMPAC scheme with regards to enacting optimised continencies and remedial actions.

The proposed scale is the minimum required to evaluate the new WAMPAC concept in the context of the GB transmission network.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The project will be desktop based but will involve some data collection from the NGET network. The supplier will deliver this work from their own offices.

Revenue Allowed for the RIIO Settlement

Not Applicable

Indicative Total NIA Project Expenditure

Total NIA expenditure: £202,500

Project Eligibility Assessment Part 1

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations

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

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

The project supports the energy system transition through two mechanisms relating to enhanced system monitoring and protection, automation and control schemes:

- The energy system transition will require more efficient use of existing infrastructure. Detailed analysis of the monitoring data will enable a better understanding of system capacity, stability and safety.
- WAMPAC schemes will help facilitate the security of the electricity network in the context of high penetration of renewable energy resources.

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

Not applicable

Please provide a calculation and/or description of the expected benefits of the solution

Due to the low TRL level of this technology an accurate quantitative benefit assessment is not possible at this stage. However, some high-level estimates of benefits can be attempted as follows: The Wide Area Control Framework will deliver benefits via three value levers. Effective WAMPAC can reduce the likelihood or extent of a blackout or loss of supply by enacting appropriate contingencies. The potential contribution from a WAMPAC scheme could be £150,00 per year. The second value lever aims at the reduction of constraint costs which are forecast to rise in future. Modelled constraint cost exceeds £500M per year for the foreseeable future and a cautious estimate of a 2% reduction due to WAMPAC could deliver £10M benefits per year. Finally, the enhanced system awareness of the new WAMPAC framework will contribute to optimised network investment and is expected to increase effectiveness of network investment by £37.5k per year. Expected rollout cost could be in the region of £170M and taking into account the project cost of £225k the overall benefit can be estimated. The current project work will improve the readiness of such solutions by increasing the TRL level. Assuming that this work contributes to 10% of the development, the relevant 10% of the available benefit is claimed for this project with a NPV of the benefit being approximately £1M.

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

The project reports will document the methodology, modelling tools and techniques and results obtained to enable any network licensee to replicate the method on their respective networks and benefit from the learning and foreground IP generated in this project.

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

As discussed in the benefit assessment, the nature of the work at low TRL level adds significant uncertainty to any cost estimates. The wide area monitoring infrastructure is scheduled to be delivered as part of RIIO T2 investments and therefore the estimated cost to add control and automation functions has been estimated at £17M for 10 sites, hence £170M. A more detailed assessment of the rollout cost will be included in the post project CBA.

Requirement 3 / 1

Involve Research, Development or Demonstration

Projects 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

Involve Research, Development or Demonstration - Please select all that apply

☑ 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 learning from this project, as documented in the project deliverables, will benefit all network licensees. The results of the research will be documented in the project deliverables and the learning will be made available to all network licensees. Based on the outcomes, other networks can replicate the network modelling and monitoring tools and deliver WAMPAC schemes appropriate to their networks.

Not applicable

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. Networks must explicitly mention similar projects that they have considered and how these differ.

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

A review of ongoing and previous projects has not shown any duplication with regards to this work. This project is building on the experience gained from previous projects such as VISOR (SPTEN01), Enhanced Frequency Control Capability (EFCC) (NGETEN03) & Power Potential (NGET_UKPN_TDI2.0).

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

Not applicable

Additional Governance And Document Upload

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

Wide area control and automation functions based on real time monitoring data and system modelling are not currently available and are a concept that is currently at a low TRL level. With improved network monitoring data and more powerful modelling tools new opportunities for WAMPAC have arisen which are being explored in this project working towards the longer-term goal of autonomous self-optimising networks.

Relevant Foreground IPR

The foreground IPR created in this project will be embedded in the project deliverables, i.e. the reports, and simulation results. The design and configuration of the new WAMPAC schemes evaluated in this project will be described in detail and made available to stakeholders. The learning from this project can be used by other licensees without access to the background IPR.

Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

- A request for information via the Smarter Networks Portal at https://smarter.energynetworks.org, to contact select a project and click 'Contact Lead Network'. National Grid already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website at https://www.nationalgrid.com/uk/electricity-transmission/innovation
- Via our managed mailbox box.NG.ETInnovation@nationalgrid.com

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

There is currently some uncertainty regarding the feasibility, effectiveness and overall cost of deploying advanced WAMPAC solutions. This is preventing the development of innovative solutions of this type through BaU routes. This initial assessment and proof of concept will contribute to de-risk the concept and is likely to lead to significant follow up BaU innovation work. The commercial and technical risks are described below.

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

Technical risks:

Whilst system monitoring and modelling technologies have matured, carrying out real time modelling based on monitoring data and driving controllable plant on the transmission network in a closed loop feedback control system carries some technical risk with regards to feasibility, stability and effectiveness. These issues need to be studied carefully to avoid putting the network at risk. A staged approach from desktop study, small scale validation to wider deployment will be required to build confidence in this approach.

Commercial risks:

Whilst the value levers identified in the cost benefit assessment clearly indicate very high potential for commercial benefits to consumers, the effectiveness of the proposed method and the development and rollout costs of new WAMPAC solutions needs to be validated.

This project has been approved by a senior member of staff

☑ Yes