NIA Project Registration and PEA Document

Date of Submission

Feb 2020

Project Reference Number

NIA_UKPN0056

Project Registration

Project Title

Cold Start

Project Reference Number

NIA_UKPN0056

Project Licensee(s)

UK Power Networks

Project Start

February 2020

Project Duration

1 year and 1 month

Nominated Project Contact(s)

Romina Arefin

Project Budget

£184,349.00

Summary

This project is a desktop study based on modelling and simulation looking into exploring the problem surrounding cold start/cold load pick-up.

This desktop study will inform UK Power Networks' policy around cold start operation and will unlock future studies on technological applications and/or commercial solutions for the management of this issue. The simulations will investigate the phenomenon and will help UK Power Networks' strategy for a low carbon/ electrified heat future.

A software tool will be used to aid the network simulation called EnergyPath® Operations, a tool developed by the Energy Systems Catapult for conducting in-house operational-timescale simulations of energy systems.
Cold Start is expected to be Phase 1 of a larger project. It is the first step towards understanding the issues related to cold load pick up and their extent. The findings will inform a second phase that will focus on how UK Power Networks will address these issues and will investigate a range of possible solutions. It is expected that UK Power Networks will develop Phase 2 of the project with other organisations based on the recommendations from Cold Start.

Third Party Collaborators

Energy Systems Catapult

Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

Problem Being Solved

Current methods of power restorations do not account for heavily loaded low voltage (LV) networks with low diversity when being reenergised In a future with high penetration of Electric Vehicles (EVs) and other loads (e.g. heat pumps(HPs) and electric heating) connected at the LV level this will create unexpected problems. When the power is restored following a prolonged outage at a high voltage (HV) level, all these devices are likely to come back on with low diversity (e.g. all not smart EV chargers will start charging at restoration) in particular sections of the LV network. This lack of diversity at the LV level could potentially cause repeated faults in

certain areas with high penetration of EVs/HPs and electric heating (especially in winter).

As a result, this could require labour intensive LV fuse replacements and it is expected to cause an increase in Customer Interruptions (CIs) and Customer Minutes Lost (CMLs). It is expected that this will increase the time needed to restore power to customers as well as operational costs.

Method(s)

This project is a desktop study based on modelling and simulation looking into exploring the problem surrounding cold start/cold load pick-up.

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Scope

The scope of the project is a desktop study to investigate issues associated with restoring electrical power to a distribution network segment after an extended period of time, where the wider GB electricity system has remained operational in the interim ("cold start"), in a future world where a greater proportion of domestic heating and transport are electrified.

The project will construct a simulation model of a small area of the electricity network (including consumers) to assess the behaviour of demand following power restoration.

The outputs from this project will be made available through four sequential deliverables:
1. D1 Interim feedback – construct simulation under 'normal' scenario(presentation)
2. D2 Resolved feedback – construct and run consumer and LCT background scenarios for both balanced and unbalanced networks (presentation)
3. D3 Final written report (content as D2)
4. D4 Dissemination and next steps (presentation/workshop)

Objective(s)

The overarching aim of the project is to improve the understanding of the issues associated with restoring electrical power to a distribution network segment after an extended period of time, where the wider GB electricity system has remained operational in the interim ("cold start"), in a future world where a greater proportion of domestic heating and transport are electrified.

The overall aim has been divided into the following Objectives:
• Objective 1: Simulate loads on electricity system in a future "cold start" scenario with greater electrification of heat and transport.
• Objective 2: Derive insights from model data regarding future electricity system (e.g. new After Diversity Maximum Demand values and potential resulting impact on design standards).
• Objective 3: Create recommendations on integrating findings into UK Power Networks' Business as Usual processes.

The intention is that the outcome of this work will contribute to improve UK Power Networks' ability to respond to future demand scenarios. In particular, the broader landscape of work within which this project is situated seeks to provide meaningful recommendations for approaches to handle cold start, involving cost-benefit comparisons between network reinforcement and smart control systems.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The following outcomes will be considered when assessing the success of the project:

• An increased understanding of cold start scenario
• Recommendations on potential areas of future work
• Inform UK Power Networks' heat strategy

Project Partners and External Funding

The project will be delivered in collaboration with Energy Systems Catapult (ESC). ESC have expertise around whole energy system analysis and solutions and are technologically agnostic.

Potential for New Learning

This desktop study will inform UK Power Networks' policy around cold start operation and will unlock future studies on technological applications and/or commercial solutions for the management of this issue. The simulations will investigate the phenomenon and will help UK Power Networks' strategy for a low carbon/electrified heat future. These suggestions could then be further studied in a trial (as a potential follow-on Cold Start Phase 2 project separate from the current project) or could be integrated directly into business as usual for all DNOs depending on the complexity and change compared to current methods. The reports will be available for other DNOs and the findings will be presented at relevant events.

Scale of Project

This project will be a desktop study. It will investigate the potential problems incurred from a cold start scenario for a generic rural network. This is the minimum scale required to gather sufficient evidence to make it relevant to the wider GB network.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL6 Large Scale

Geographical Area

This is a research project and the modelled network will have similarities to UK Power Networks' rural networks in Eastern Power Networks and South Eastern Power Networks making the findings applicable to most rural networks in GB.

The solutions identified through this project are not expected to be area-specific; however they might depend on the level of penetration of low carbon technologies. They are expected to be applied to any licensee area with a similar level of penetration of EVs/HPs/electric heating in the future.

Using ESC EnergyPath® Operations tool helps to keep the finding relevant to all network operators as it is based on generic data rather than a specific case.

Revenue Allowed for the RIIO Settlement

No revenue allowance was included for this purpose in RIIO Settlement.

Indicative Total NIA Project Expenditure

This project will cost £184,349 of which £165,914 (90%) will be NIA funded.

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:

n/a

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

n/a

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)

This is a research project and as such it won't deliver direct benefits to the electricity network but the follow up from this project is expected to deliver benefits by improving current operational practices and opening up a new use case for network outage management.

Please provide a calculation of the expected benefits the Solution

N/A as this is a research project.

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

The outputs from this project and the findings are applicable to all GB networks subject to locational and network specific requirements.

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

As this is a research project, UK Power Networks is not expecting any rollout costs but the findings will help inform better operational practices. This project will also explore in detail the scale of the problem to justify the need of a second phase which would look into mitigation methods and a potential trial.

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 learnings form this desktop study will be available for all DNOs to use and inform their policies and operational work around cold start scenarios. This scenario will be applicable to any network with a high level of penetration of low carbon technology and particularly electric heating and HPs (as these are less likely to be part of a smart technology rollout unlike EVs). It is most likely to affect networks with a higher risk of a long outage (such as rural areas which are not interconnected).

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

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

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.

There is currently no research modelling in detail LV cold load pick-up effects. This project will be the first to do this with a GB network model and not looking only at a case study.

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

n/a

Additional Governance And Document Upload

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

This project is exploring a problem which is yet to be explored in detail by networks in GB. This is a novel problem that arises with the increase of electrified heating and as such it is an un-investigated topic.

Relevant Foreground IPR

n/a

Data Access Details

n/a

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

activities

There is currently no certainty on the scale of problem and its potential impact and it is important to invest on research at this stage while the business case is still to be proven. Due to the high risks associated with an unknown problem this project cannot be undertaken as business as usual.

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

This is research project looking into modelling a network scenario not experienced as of yet in GB due to the low penetration of electrified heating. There is currently no certainty on the scale of problem and its potential impact and it is vital to invest on research at this stage while the business case is still to be proven. Due to the high risks associated with an unknown problem this project cannot be undertaken as business as usual.

This project has been approved by a senior member of staff

☑ Yes