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

Feb 2018

### Project Reference Number

NIA_NPG_020

## Project Registration

### Project Title

Smart Network Design Methodologies

### Project Reference Number

NIA_NPG_020

### Project Licensee(s)

Northern Powergrid

### Project Start

February 2018

### Project Duration

1 year and 10 months

### Nominated Project Contact(s)

Chris Goodhand

### Project Budget

£400,000.00

### Summary

The present design and modelling tools for LV systems are more simplistic than those used for HV & EHV planning. This was acceptable when the LV network was load centric but is no longer the case. This project aims to address that deficiency.

### Nominated Contact Email Address(es)

yourpowergrid@northernpowergrid.com

### Problem Being Solved

The present design and modelling tools for LV systems are more simplistic than those used for HV & EHV planning. This was acceptable when the LV network was load centric, passive in nature and accurate monitored (SCADA or Half-Hour metering) datasets were not available. Modelling tools are either spreadsheet based solutions that consider a typical end user demand (e.g. After Diversity Maximum Demand (ADMD)) or software like the LV DEBUT tool that uses annual consumption figures. These tools are based on a single "worst case" maximum demand scenario rather than seasonal, condition, location/hierarchy or a combination of them. These all factors combined can lead to inaccurate and over-engineered solutions as they are based on pessimistic assumptions of the LV system utilisation and operating conditions.

LV network modelling has typically been undertaken on individual LV feeders using these simplistic spreadsheet models or simplified probabilistic modelling approaches. Whilst probabilistic modelling can provide a good understanding of the impact of varying demand profiles and embedded generation rather than behaviour at peak loading, it is not based on actual power flow modelling. It also does not enable analysis of the wider LV network and the capture of any interdependencies across voltage levels from 132kV down to LV. With the advent of SCADA and smart meter data at LV and growth of different low-carbon technologies, the methodologies/assumptions employed by the current analysis tools are rapidly becoming out-of-date. For instance, when carrying out voltage studies downstream of the final voltage controlled bus (i.e. primary tap changer), several uncertainties are present such as the representation of bus voltage variation with load within the local and wider network. These uncertainties have led designers to use rudimentary and deterministicassumptions when assessing voltage regulation. However, on site voltage measurements show these assumptions can lead to over-reinforcement in urban areas and under-reinforcement in some rural networks.

Also, when assessing the holistic effects of advanced voltage control techniques such as Load Drop Compensation (LDC), existing design tools are not fit for purpose as the low voltage networks are not modelled together with the EHV and HV models.

## Method(s)

The project will aim to build on exiting innovation project learnings in the LV network design based on existing methods and develop smart network design methodologies for EHV/HV and LV with additional input data like substation network monitoring and smart metering based on two test IPSA network models.
The project methodologies will look at addressing the challenges like phase connectivity, voltage management and aggregation faced by distribution network operators for smart metering data utilization and understand the impact on accuracy of results.
The project methodologies will also look at validating our existing equipment specifications and network design/planning assumptions based on the holistic network modeling of the different voltage levels.
The methodologies finally will form a set of requirements for a future functional specification for new power system software.

## Scope

The project will be split in five individual workstreams with some interdependencies as the following:
· Workstream 1 - Horizon scanning: Will conduct the required literature review to gather learnings from previous and present innovation projects in regards to this project. Selected use cases will be mapped against the requirements of this project and test networks will be identified.
· Workstream 2 - LV Network Model methodology: Will undertake the model build for the test networks identified previously, addressing the challenges of customer load definition and phase connectivity based on the various data inputs, especially smart metering data.
· Workstream 3 - Multi-Voltage Level methodology: Will enable a more holistic assessment of the impact of a wide range of network loads/states on power flow and voltages, leading to improved recommendations on voltage control and management.
· Workstream 4 - Smart Meter Data Analytics: Will define and articulate how data and analytics can assist in dealing with the challenges of utilising smart metering data in network design and planning.
· Workstream 5 - Novel Analysis technique: Will explore and compare different novel network modelling analysis techniques that could be applied and from this, develop a set of user requirements to inform a future functional specification for new power system software.

## Objective(s)

The objectives of this project are to:

- · Deliver recommendations on improved network EHV/HV/LV network build and holistic network analysis under a range of conditions.
- · Recommendations to improve network planning and design solutions.
- · Recommendations on how to deal with challenges for smart meter data utilisation.
- · Validation of equipment specifications.
- · Creation of set of requirements for future functional specifications of new power system software.

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

## Success Criteria

The Project will be successful if :

- · The network methodologies actually propose potentially acceptable solutions for smart metering challenges which will significantly improve the design and planning assumptions especially at LV.
- · The network methodologies allow the modelling of more innovative solutions due to the improved knowledge and visibility of the holistic operation of the combined networks.
- · The network methodologies assist in achieving the potential £5M of network reinforcement benefit due to use of smart metering data.

## Project Partners and External Funding

n/a

## Potential for New Learning

Key new learning that will be developed from this project will include:

- · Recommendations on a methodology, trialled via LV system modelling, for improved efficient LV network model build, analysis and validation considering:
- o Use of aggregated data from smart meters and other relevant network data and
- o Uncertainty in network phase connectivity
- · Recommendations on a methodology for multi-voltage level network model build, analysis and validation,
- from EHV to LV.
- · Recommendations on novel analysis techniques for LV and multi-voltage level network models to improve understanding of holistic network behavior under a range of conditions/states.
- · Summary of benefits to network planning and design (and operation at a high level) e.g. network utilisation, voltage regulation etc. for a range of agreed Use Cases.
- · Recommendations on innovative solutions for plant specifications and network operating points for example. Would include review of equipment specifications (like ER P1 for supply point transformers, ER P10 to include for tap ranges and ratios plus internal guidance documents) and inform optimum distribution transformer tap changer positions, target voltage set points and bandwidth.
- · A set of user requirements for a future functional specification for a future network planning & design tool
- that can be used by DNOs to make best use of smart metering data.
- · Identification of interface requirements to existing DNO IT systems such as Oracle eSpatial, GE Power-on
- and Siemens Energy IP.

## Scale of Project

The Project will be limited to trialling on a two EHV/HV and LV combined test networks.

## Technology Readiness at Start

TRL4 Bench Scale Research

## Technology Readiness at End

TRL4 Bench Scale Research

## Geographical Area

The precise network location will be determined following the completion of initial analysis which is a part of the project.

## Revenue Allowed for the RIIO Settlement

None

## Indicative Total NIA Project Expenditure

£400, 000

# 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)

Northern Powergrid's current well justified business plan estimates £5m of smart metering benefit accrued to NPg on network reinforcement expenditure during 2015-2030. It has been assumed that smart metering benefits will start to be delivered post 60% smart metering penetration. This project will assist in achieving the £5m benefits by addressing the challenges of utilizing the smart metering data in our existing planning & design processes.

## Please provide a calculation of the expected benefits the Solution

Project has initial TRL of 3 and precise benefits are currently uncertain.

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

The approach is relevant and applicable to all GB DNOs.

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

Roll-out costs across the whole of the GB network are estimated at less than £1m.

## 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 learning could be utilized by all UK DNOs who want to improve the design and planning of network utilizing smart metering data and want to understand the holistic operation of all the voltage levels.

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

The Northern Powergrid innovation strategy specifically details the needs to develop improved network planning and design tools. There is also the potential to use the project's output as a way of validating our existing equipment sizing standards as transition our networks into a smarter grid. This potentially supports our explicit strategy activity to develop the DSO role.

☑ 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.

A review of all other Network Licensees NIA reports has been performed and no exactly similar projects have been identified or any registered since these reports were last published.

### 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

Smart meter data in sufficient volumes has not been previously available and the method therefore could not have been trailled previously.

### 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

The project methodology is relatively immature and there is. by implication, a relatively high risk that the project does not deliver the promised benefits, either as part of the project itself or. once the potential impact of roll-out has been assessed.

## 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

Alternative external or other funding mechanism that support this type of internally focussed work could not be identified. Funding mechanisms tended to be aimed at SMEs and funding is entirely discretionary.

## This project has been approved by a senior member of staff

☑ Yes