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

Mar 2015

Project Reference Number

NIA_SPT_1504

Project Registration

Project Title

Managing uncertainty in future load-related investment

Project Reference Number

NIA_SPT_1504

Project Licensee(s)

SP Energy Networks Transmission

Project Start

February 2016

Project Duration

3 years and 11 months

Nominated Project Contact(s)

James Yu (Future Networks Manager)

Project Budget

£300,000.00

Summary

To model the uncertainties underlying changing demands on the network and therefore the need for load-related investment.

Nominated Contact Email Address(es)

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Problem Being Solved

Difficulty is already being experienced in dealing effectively with uncertainty in demand and wind generation output in network planning and operation. PV generation is also becoming significant in some areas, and is demonstrably adding to the level of uncertainty in assessing network capability and adequacy. The expected increase in uptake of electric vehicles, heat pumps and other low carbon technologies will further increase the level of uncertainty which is encountered in both planning and operational timescales. Without action to directly model and analyse these uncertainties, two risks may arise in relation to planning and operation of the network:

- Over-conservatism in which the network is reinforced to ensure that it will have a higher power transfer capability than turns out to be necessary. This results in overinvestment in assets which are not fully utilised in providing the required level of service and reliability.
- Under-investment, such that the ability of the network to accommodate future patterns of generation and demand is significantly limited by network constraints with an associated impact on (a) facilitation of connection of generation and (b) reliability in meeting demand.

Existing models and techniques used to analyse the variability and correlations of demand and generation (and hence their impact on network flows and voltages) are not sufficient to deal adequately with the scale of adoption of these new technologies. There is therefore a need for a new and more rigorous approach, making use of probabilistic representations of the behaviour of existing and new generation sources and demand types, both individually and in aggregate. Furthermore, methods are needed to exploit these models to allow the need for and benefits of traditional and novel interventions (such as ‘smarter’ network control and operation) to be assessed and compared. Given adequate information obtained from a suitable software tool and pertaining to a number of credible scenarios, it should be possible for a network planner to identify an appropriate network investment strategy to mitigate the risks

outlined above.

Method(s)

Given suitable models of the time variation of both demand and generation output, their relationship with number of installations and correlations between them, the overall approach will then be to use simulation techniques to examine a large range of 'scenarios' of possible future operating conditions and demands on the network. These system operation scenarios will be constructed by sampling from the statistical models, collectively and consistently so as to represent a coherent picture of uptake of technologies of interest, and of the behaviour of those technologies as well as of traditional loads. The use of robust models and sampling techniques will ensure that the resulting database of network operating states and external conditions is statistically representative of situations likely to arise. The database can be interpreted, analysed and 'mined' using statistical techniques to identify:

- The most likely violations of network operating constraints, their nature, e.g. thermal or voltage, and their severity
- Common factors underlying violations of constraints
- Impacts in terms of Customer Interruptions (CI) and Customer Minutes Lost (CML)
- Priority network locations for intervention, and the nature and cause of the problem to be solved
- Trigger points for intervention in terms of load growth or Low Carbon Technologies (LCT) uptake, observed network behaviour, etc.

Learning from previous IFI, LCNF, NIC and NIA work, as well as wider international experience can then be applied to suggest the most suitable intervention (including traditional reinforcement) to relieve the identified and forecast problems.

Scope

To model the uncertainties underlying changing demands on the network and therefore the need for load-related investment.

Objective(s)

- To make use of statistical relationships between weather/time of day/season and the demand/output of individual and aggregated LCTs and underlying demand.
- To provide the capability to model the uptake of LCTs with respect to customer type etc.
- To identify and model a suitable exemplar network for test purposes.
- To construct and demonstrate a framework to sample uncertain factors influencing use of a network and simulate network performance under each of a large number of instances of those variations to produce a database of input-linked outcomes
- To develop methods of interrogating and analysing the database to identify intervention priorities and the underlying network, demand and LCT conditions which trigger them
- To apply the models, framework and methodology to the selected exemplar network to identify 'weak points' and 'points of pressure', assess overall intervention need and urgency, identify suitable interventions.
- Compare results with existing Business as Usual (BAU) planning methods.

> The development of a 'production quality' software tool is not an objective of this project. In order that investment risk is reduced, the development of such a tool will be considered under a subsequent/parallel project once the learning derived from this project is sufficiently developed.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

- Establishment of external influences on the need for network development – generation and demand including installation of solar PV – can be modelled probabilistically in an efficient manner providing useful information to network development planners and network designers on network performance under different conditions.
- Evidence to support a decision on whether or not to engage with a professional software provider to develop a production grade, supported software tool enabling probabilistic network planning.
- Specification for suitable professional simulation and analysis tools to exploit models of external influences on network adequacy and for a tool to interrogate and analyse its outputs.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The proposal is to focus the analysis on one Grid Supply Point (GSP) in the ScottishPower Transmission (SPT) area.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

As a minimum, one GSP in the SPT area.

Revenue Allowed for the RIIO Settlement

Not applicable.

Indicative Total NIA Project Expenditure

£300,000

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)

Some key benefits are expected to result from the proposed project:

- Improved models of the behaviour of new generation and load technologies which will quantify the level of uncertainty in their behaviour and explain their behaviour in terms of system and environmental conditions
- Improved understanding of the behavioural links between new demand and generation technologies and traditional 'underlying load'
- Methods to apply this understanding to robustly identify part of the distribution network in which the risk of lack of network capability is highest, and to identify suitable interventions to reduce that risk

Customers will benefit through a combination of a reduction in unnecessary investment in network interventions, better targeting and timing of 'smart' interventions to relieve expected constraints, and a reduction in the extent to which uptake of new and low-carbon demand and generation technologies is constrained by inadequate network capability. In addition, the human resource required will be much reduced when seeking to obtain information on the likely impact of uncertain external variations so as to inform robust network investment.

Please provide a calculation of the expected benefits the Solution

Research project: N/A

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

If successfully developed in accordance with expectations at the outset and once any issues that can only become apparent through a development phase are resolved, the method will be readily applicable to most if not all network operators.

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

Once professional software facilities are developed (through a separate project, as noted elsewhere), replication costs are expected to be low – some customisation of certain models will be required, as would a limited amount of data gathering to parameterize other models. The costs of this would be dependent on the effort required to extract existing data in a suitable form from network operators, and to gather any supplementary data needed.

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 developed models will be made available for use by other network operators, as will documentation on the techniques and data sources used to create them. Some models will be suitable to be directly reused by other networks operators (e.g. models of LCT behaviour), while others (e.g. models of underlying load) could be adapted and customized as required using the documented methods.

The modeling and simulation framework and interrogation and analytical techniques used will be fully documented. This documentation will be available to other network operators who wish to replicate the work. Prototype implementations of these methods will be made available to network operators who wish to trial the methods in their own networks, or to directly participate in development of 'production quality' software. As previously noted, it is not the objective of this project to develop such software, but rather to produce the knowledge and learning required for a subsequent or parallel project to achieve such an outcome.

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.

n/a

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

n/a

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

n/a

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

n/a

This project has been approved by a senior member of staff

☑ Yes