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NIA Project Registration and PEA Document

Date of Submission

Jun 2016

Project Reference Number

NIA_UKPN0018

Project Registration

Project Title

Efficient network constraint management through the use of market signals

Project Reference Number

NIA_UKPN0018

Project Licensee(s)

UK Power Networks

Project Start

June 2016

Project Duration

1 year and 3 months

Nominated Project Contact(s)

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Project Budget

£250,000.00

Summary

To develop a market design for the efficient management of constraints on the distribution network, allowing the participation of multiple technology types, and providing a signal to the DNO when it is economically sound to reinforce. This project will not trial this market design, but will result in principles and draft Commercial Heads of Terms for use in any subsequent trial.

Nominated Contact Email Address(es)

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Problem Being Solved

The increasing prevalence of distributed generation (DG) creates additional challenges for balancing the system. There is also an increase in the range and number of flexibility providers on the distribution network that could be utilised to provide system services. DG, storage and flexible demand, therefore, create both a need for, and enable, more active system management at the distribution level.

Whilst a consensus is emerging that some form of Distribution System Operator (DSO) role needs to be taken on to make efficient use of distributed flexibility options, it is not clear at this stage what form the DSO model should take. There is a requirement, therefore, to explore and trial some of the possible approaches in order to develop understanding of how best to proceed.

UK Power Networks' (UKPN) Flexible Plug and Play (FPP) project ran between 2012 and 2014 under the Low Carbon Networks Fund. FPP was an innovation project trialling new technologies and commercial arrangements in order to connect DG, such as wind or solar power, to constrained areas of the electricity distribution network. It was intended to deliver greater flexibility in accommodating cheaper and faster DG connections, as well as enabling previously unviable DG schemes to become feasible.

Under the scheme, in addition to receiving the conventional connection offer, customers in an FPP area were offered an interruptible connection. This connection offer would typically come at a lower cost to the connecting customer, but would allow UKPN to curtail the

customer's generation output in times of network constraints. The network monitoring, data analysis and asset control was carried out by an Active Network Management (ANM) system, which managed predefined and pre-agreed principles of access. The principles of access trialled under FPP were a combination of "pro rata" and "Last In First Off" ("LIFO").

FPP successfully demonstrated that lower-cost connections could be offered, that were commercially viable for DG customers; however further opportunities to improve the service offered to customers have been identified:

1. Whether LIFO or pro-rata approaches are used, the curtailment applied is not always economically optimal for two reasons. First, LIFO and pro-rata approaches do not have a mechanism for considering which generators have higher or lower opportunity costs and which may be curtailed before others to minimise impacts. Second, there is no recognition of the proximity of a generator to a particular constraint, meaning that a generator with little ability to alleviate the constraint may be curtailed fully whereas an alternative generator could only be partially curtailed to achieve the same effect.
2. Mechanisms for generators to signal their willingness to reduce or increase their curtailment risk by trading with other scheme participants could better facilitate optimum curtailment decisions.
3. There is no mechanism for introducing multiple technologies, which is required in order to incorporate the storage assets that have come to the fore since the inception of FPP. Properly integrating such technologies could provide the required constraint management at a lower cost.
4. There is no signal provided to the DNO to reinforce the network, even if the overall cost of curtailment exceeds the reinforcement cost.
5. It is a strictly DNO solution, creating known conflicts in parts of the network where there are distribution-connected Balancing Mechanism Units (BMUs) or where there are transmission constraints. New commercial and technical interfaces between industry parties will become increasingly important. Correspondingly, it is not well suited to managing multiple interacting constraints, resulting in multiple stacks depending on the location and nature of the constraint.
6. Finally, curtailment is only based on real power output, whereas alternative approaches can be taken to alleviate the constraints including adjusting generator power factor.

Method(s)

Building on the findings of the original FPP project, the project will review the approach taken previously and propose new commercial strategies in order to address the aforementioned limitations. Alternative approaches to managing flexible connections will be explored, including how demand side response (DSR) and storage can be better accommodated. This work will be integral to informing future DSO operation. The project would comprise the following steps:

- Defining a set of criteria against which schemes should be assessed, reviewing the existing FPP scheme against those criteria and take into consideration future generation customers, to note areas of good practice and identifying areas where modifications may be required.
- Developing, at a high level, a number of alternative schemes for managing interruptible contracts.
- Assessing each of these schemes against the criteria, and prioritising them with a view to generating a shortlist (or potentially a single approach) that can be trialled.
- Engaging with existing and potential customers to inform the criteria setting and assessment.
- Carrying out a more detailed desktop analysis on the selected shortlist of designs in order to explore these in more detail, including, for example, an analysis of how different stakeholders would be affected. This will be completed to quantify the relative merits of the market design options and how the preferred market design could be taken forward to trial.
- Developing draft Commercial Heads of Terms between the DNO and network customers that could be used as the basis for any subsequent trials.
- Carry out a more detailed Impact Assessment of shortlisted designs on internal control systems and organisational processes.

The assessment criteria would be developed on the basis of one or more workshops. It may be appropriate that the following themes may be covered in this work:

- What is the cost associated with curtailment by existing and potential generation customers, and hence what would be the relative position of their bids?
- How does this compare to the expected bidding behaviour of alternative flexible approaches such as electricity storage and DSR aggregators?
- Does the approach provide the appropriate signals not only to ensure efficient curtailment, but also to encourage flexible providers to connect at optimal locations on the network?
- How would the bids be made, assessed and processed, and by whom? How and when does money change hands?
- Are there any risks of non-competitive bidding behaviour (e.g. small numbers of participating customers) and what mitigating options exist?
- How does the approach interact with other actions being taken on the electricity system (e.g. effect on transmission-level constraints, or conflicts with TSO actions taken on embedded BMUs)?
- How well does the scheme work across multiple technologies?
- How is the reinforcement trigger signalled?

Scope

To develop a market design for the efficient management of constraints on the distribution network, allowing the participation of multiple technology types, and providing a signal to the DNO when it is economically sound to reinforce. This project will not trial this market design, but will result in principles and draft Commercial Heads of Terms for use in any subsequent trial.

Objective(s)

The aim of this project is to develop an improved approach to managing distribution network constraints, focusing on three key objectives:

1. Develop market-based mechanisms (i.e. price signalling) to enable more efficient curtailment actions.
2. Being compatible with multiple technology and commercial solutions (wind, solar, batteries, DSR).
3. Providing appropriate signals to the DNO to reinforce when economically sound to do so.

It is also anticipated that this work will provide insights into the future workings of a DSO model. As such, an objective of this work is that the market models investigated address some of the questions that will be important for the DSO model, including:

- The commercial and technical interaction between DNO actions and the requirements of the System Operator (SO)
- The role of third party aggregators, and in particular their interaction with the DNO
- How the DNO's role changes as it moves towards a DSO function, including real-time constraint management, contracting for commercial services, and potentially providing (or facilitating the provision of) services to the SO.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project is deemed successful if:

1. The proposed solution meets the objectives and industry has been consulted in its development; and
2. The proposed solution is worth progressing to formal trials with market participants.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This project comprises desk-based analysis and workshops, including the use of external consulting expertise and communication with key interested parties.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

The majority of the project work will be undertaken as desk-based analysis, using the UKPN network areas for this study. The principles will, however, be applicable to all GB regions.

Revenue Allowed for the RIIO Settlement

There are no allowed revenues associated with market based models for curtailment in UKPN's RIIO-ED1 settlement.

Indicative Total NIA Project Expenditure

£250,000

Project Eligibility Assessment Part 1

There are slightly differing requirements for RII0-1 and RII0-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RII0-2 / RII0-1).

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 RII0-2 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 (RII0-1 projects only)

The Flexible Distributed Generation (FDG) programme enables more connections in constrained areas of the distribution network than would have been possible otherwise. In return for cheaper and faster connections the customer takes the curtailment risk, which has been up to 10% of the time. Its introduction has to date enabled over 20 DG projects and 170MW, to connect faster and cheaper saving customers over £70m in connection costs. UKPN continues the roll out of flexible connections and it is expected that the MW capacity connected on flexible arrangements will continue to grow as will the curtailment levels.

Using a typical value for the curtailed DG energy, estimated at £100/ MWh for renewable DG, a scenario with full 10% curtailment would result in £2.24m reduction in annual revenue for the 170 MW of DG customers. The project seeks to develop and consult with the market on new innovative frameworks to reduce the amount of curtailment and therefore their reduction in revenue.

Previous work that Baringa has carried out for Elexon has shown that moving from rules based (LIFO/Prorata) approaches to market based mechanisms can deliver reduction in the cost of curtailment ranging from 5% to 45% depending on the scenario. This will mean overall lower system costs but also increased headroom to connect additional generation onto the network.

Please provide a calculation of the expected benefits the Solution

Not applicable for this research project.

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

The proposed FPP approach could be adopted by all DNOs, and would be particularly beneficial for DNOs facing export constraints, or where there are local transmission issues.

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

The cost of roll-out is dependent on the proposed solution. The Control System Impact Assessment should identify the major upgrades and cost drivers for further investment needed to deploy the solution.

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 use of new commercial arrangements to improve the efficiency of connection and curtailment could be applied by any DNO connecting DG and storage customers to a constrained part of a distribution network. Project findings will add to the experience and evidence for all DNOs in the DNO to DSO evolution.

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

Of the challenges identified within UK Power Networks' innovation strategy, this project would most directly affect the following two:

1. "Climate and energy landscape": UKPN identified that distribution networks need to accommodate renewable generation on their networks in order for the UK to meet its binding obligations; this project would facilitate this transition by ensuring that generation customers are allowed to connect quickly and at minimal cost, and that they can access the network to market their output with minimal disruption
2. "The need for smart grids": UKPN recognises that the "smart grid" entails a wide range of activities, but the key application for this project is in helping to remove some of the uncertainty surrounding the transition from passive DNOs to more active DSOs, including uncertainty regarding timing, technologies and customer behaviour.

- 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