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NIA Project Registration and PEA Document

Date of Submission

May 2017

Project Reference Number

NIA_NPG_014

Project Registration

Project Title

Vehicle to Grid (V2G) - the network impact of grid-integrated vehicles.

Project Reference Number

NIA_NPG_014

Project Licensee(s)

Northern Powergrid

Project Start

May 2017

Project Duration

3 years and 1 month

Nominated Project Contact(s)

Andrew Webster (Project Manager)

Project Budget

£250,000.00

Summary

The project primarily covers LV network impact, from design, operational and power quality perspectives.

An assessment of the network impact of V2G as successively increasing numbers are rolled out in a phased implementation will be undertaken.

The project will assess and quantify this impact and make any recommendations to mitigate, or otherwise, resulting from the widespread use of this technology.

An assessment of likely customer behavior will also be undertaken. this may provide an indication of the likely speed of take-up of this technology as well as other network relevant insights.

Third Party Collaborators

Nissan

E.ON

Newcastle University

Imperial College London

Nominated Contact Email Address(es)

yourpowergrid@northernpowergrid.com

Problem Being Solved

The potential emergence of Vehicle to Grid (V2G) services could mean that a high proportion of electric vehicles not only charge from our network but also discharge on to it as they provide fast frequency response to National Grid and, potentially, other grid services. This is a new feature on the Northern Powergrid network and the impact is not fully understood. This is a pressing issue; the actual delivery technology is already well developed and could be quickly implemented. Financial incentives for vehicle owners could accelerate this further.

The impact of large scale uptake of the V2G systems, on the following is unknown:

Connections Process - how will our connections process need to change to recognize V2G and understand how we treat and charge for these enquiries, particularly multiple enquiries.

Avoiding / Managing DNO constraints - The Customer Led Network Revolution project (CLNR) and all research to date have viewed electric vehicles (EVs) to be a potential problem to networks above certain penetration levels. This project will research whether bidirectional V2G will increase or mitigate the predicted network constraints.

Power quality - CLNR and the My Electric Avenue (MEA) showed that there was no power quality issue associated with EV chargers at 3kW. However more frequent calls for charge or discharge to provide frequency support, or when exporting energy on to the network may cause voltage flicker or harmonic issues but this is currently unknown.

the problem is now potentially urgent as V2G technology is already being installed in new electric vehicles. Whilst this has not been activated the potential for very fast uptake of the technology is clearly present.

Method(s)

The project proposes a phased and carefully monitored roll-out of 1100 V2G sites. The V2G charging points and background technology are being provided by NUVVE and not funded by the project. This work will provide data from an extensive V2G charger implementation to allow the impact of this new type of network technology on, primarily the LV network, to be fully assessed. This in turn allows mitigation to be prioritised and operational and design practices to be optimised to support more general roll-out of V2G technology.

The project will address the following:

Planning;

Installation and commissioning;

Monitoring, analysis and determination of mitigating actions; and

Closedown and dissemination.

Analysis and mitigation activities are likely to be focussed on connections and design process, impact on network constraints and power quality although other learning is likely to be generated as the project proceeds.

Analysis of customer behaviours with respect to V2G, and the potential economic drivers of that behaviour, will be assessed by NUVVE as part of this project.

Scope

The project primarily covers LV network impact, from design, operational and power quality perspectives.

An assessment of the network impact of V2G as successively increasing numbers are rolled out in a phased implementation will be undertaken.

The project will assess and quantify this impact and make any recommendations to mitigate, or otherwise, resulting from the widespread use of this technology.

An assessment of likely customer behavior will also be undertaken. this may provide an indication of the likely speed of take-up of this technology as well as other network relevant insights.

Objective(s)

Primary project objectives of the project include:

* Determine a range of connection cost options for the customer, depending upon their total income requirements, pay-back period expectations, and other business model considerations.

* Produce enhanced network design assessment tools that take account of these options.

* Determine whether V2G can support networks during constraint periods, and to what extent, by:

A) Being allowed to discharge onto the network during periods of high load; and

B) Being inhibited from fully charging during constraint periods

* Produce new models of substation profiles that include various levels of V2G charger implementation.

* Determine V2G charger impact on power quality.

* Develop and disseminate guidance for other DNOs and interested parties.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project is research/knowledge development through a design, install, assess, mitigate and disseminate project.

The project will produce a design assessment process and associated design guidance for V2G connections. It will also produce guidance on where and how V2G may be used to mitigate network issues.

Delivery of the objectives detailed above, or an analysis of why they are not important will determine project success.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The project scale is determined by the number of charging points being delivered and installed by NUVVE. It is envisaged that a successive roll-out of 10, 100 and then 1000 points will be made. This should provide a statistically significant amount of data to be provided by the project.

Northern Powergrid will provide instrumentation at sites appropriate to monitor this roll-out of V2G technology.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

V2G installation sites will be selected from across the Northern Powergrid operational area.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£250,000

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)

The project has the potential to provide lowest cost connections solutions to V2G customers.

The current lack of knowledge of the impact of V2G systems, especially when rolled out en-masse, means that without this knowledge we are likely to be, necessarily, overly conservative in connections design. Furthermore a full understanding of issues around V2G provides DNOs with a ready to go solution that will enable the fastest possible roll-out of V2G technology which will help to deliver the business and societal benefits as fast as practical.

The main financial benefit is likely to be seen in avoided reinforcement.

Typical costs to reinforce in the case of V2G clustering, or this project identifying a high impact of the technology::

- The replacement of all or part of the LV main (£125 per metre)
- The replacement of the distribution transformer (£14,000 per transformer)

Avoiding a typical single LV feeder reinforcement would include the replacement of a transformer and 300m of LV cable, the avoided reinforcement costs would be in the region of £51.5k

Applying the project outputs to avoid reinforcement costs on just 24 schemes per year, across the whole of GB (no more than 2 to 3 schemes per DNO), then the total avoided costs would be in the region of £1.24m pa or around £10m per price control period.

Please provide a calculation of the expected benefits the Solution

This project is low TYRL and designed to generate knowledge so that the potential impact of V2G technology can be mitigated in the most cost effective manner. The project itself does not provide a direct financial benefit.

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

The method could be applied across all network licensees on the LV networks.

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

Application of the project's findings would be a trivial amount, say <£5k per licensee. Mitigation costs and benefits are unknown and

are a project output.

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

All Network Licensees will be potentially exposed to large scale roll-out of V2G systems. Consequently the learning generated by this will be relevant to all individual Network Licensees;

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

This project meets several of the innovation objectives in the Northern Powergrid. Specifically, the need to understand the potential of vehicle battery support for network constraints and the need to understand and develop the DSO role are both detailed in the published innovation strategy document as named innovation activities for the ED1 period.

- 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