NIA Project Registration and PEA Document

Date of Submission

Dec 2013

Project Reference Number

NIA_NGET0020

Project Registration

Project Title

Modelling of Embedded Generation within Distribution Networks and Assessing the Impact

Project Reference Number

NIA_NGET0020

Project Licensee(s)

National Energy System Operator

Project Start

August 2012

Project Duration

2 years and 1 month

Nominated Project Contact(s)

Djaved Rostom

Project Budget

£42,000.00

Summary

The development will establish an understanding of the current practices, analysing their relative efficiencies at modelling DG effects for designing the system as per the SQSS. The analyses will highlight conditions and factors that improve or worsen the above efficiencies. Using the results of these analyses, the project will investigate a number of candidate techniques to determine the nature and magnitude of the impact of distributed generation to transmission demand. The developed technique should be capable of dealing with wide range of DG penetration, concentration and location.

Third Party Collaborators

University of Bath

Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

Problem Being Solved

The transition to a low carbon economy will see a substantial rise of renewables in our energy mix. By 2030, around 48 GW of wind is expected to be installed on the GB system, of which, up to 40% is expected to be connected at distribution systems, ranging from LV, HV to EHV. This will fundamentally change the demand patterns seen at the Grid Supply Points (GSP) connecting to the transmission system. Currently there are no reliable tools to accurately determine the impact of DGs on the demand patterns at the transmission level, particularly, considering the effects of DG concentration, location and penetrations across the three voltages.

This project will develop methodologies to identify the collective effect of DGs on the national transmission system, so as to reduce load forecasting errors, which will in turn reduce the level of operational reserve. This will ultimately lead to much improved balancing efficiency and carbon efficiency. Furthermore with the increased visibility on embedded generation, which this research is expected to deliver, a more accurate representation of the demand can be used in planning the system.

Method(s)

Research

The method proposed includes:

- Literature review on various assumptions and methodologies for modelling embedded generation in distribution networks and Investigation of different methodologies and their effectiveness

- Investigation of the contribution factors for large, small and medium mismatches

- Development of alternative modelling methodologies aiming at minimising the mismatches between modelled and actual EG contribution + Interim report Documenting Key Findings

- Test and validate the developed modelling methodologies on a wide range of GSPs, further enhance the alternative modelling and develop a set of rules for the GB systems + Final Report

Scope

The development will establish an understanding of the current practices, analysing their relative efficiencies at modelling DG effects for designing the system as per the SQSS. The analyses will highlight conditions and factors that improve or worsen the above efficiencies. Using the results of these analyses, the project will investigate a number of candidate techniques to determine the nature and magnitude of the impact of distributed generation to transmission demand. The developed technique should be capable of dealing with wide range of DG penetration, concentration and location.

Objective(s)

- A literature review on various assumptions and methodologies adopted for modelling embedded generation in distribution networks for power system planning in the GB system (e.g. P2/6 Standard).

- Investigation of different methodologies and their effectiveness in modelling the impacts of embedded generators on load profiles at distribution and transmission level.

- Investigation of contribution factors responsible for large, small and medium mismatches.

- Development of alternative modelling methodologies, using the identified key contribution factors to

minimise the mismatches between the modelled and measured results.

- Testing and validation of the developed modelling methodologies on a wide range of GSPs

- A report documenting the key findings.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

This project is successful if we improve the understanding of the impact of embedded generation on the demand seen at the transmission level.

Project Partners and External Funding

The University of Bath

There is no external funding being brought to this project.

Potential for New Learning

There is significant potential for new learning as this project addresses the impact of DGs on the demand patterns at the transmission level. This is something we have not looked at in depth before. We will disseminate the learning generated through the standard

channels, including the ENA smart portal, conferences, academic papers etc.

Scale of Project

This will be a laboratory based project. As such, we cannot reduce the scale any further and still provide the benefits to customers.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

This project will be completed in Bath, but will provide learning that is applicable to the whole of the transmission network.

Revenue Allowed for the RIIO Settlement

Zero

Indicative Total NIA Project Expenditure

IFI - £4,000

NIA - £38,000

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)

In planning timescales, having a clearer representation of the embedded generation in our demand or generation models will certainly improve the accuracy of the system studies carried out in National Grid. Planning the system against a more accurate demand background will help to identify more efficient reinforcements or measures that can be taken to facilitate the operation of the system in the future.

Key benefits include:

- Clarification on Contribution of Embedded Generation to meet local demand and the load profile at GSP points;

- Accurately sizing the SGTs and avoid constraints on the network as per Chapter 3 Studies of SQSS;

- Clarity on what information may be required from DNOs, and whether GSR009 assumptions with regard to embedded generation contribution can be accurately applied for all types of generators including embedded generation;

- The project will also highlight the limitations of the current standards such as the P2/6 and the SQSS with respect to modelling embedded generation. The developed tool will provide insights into more suitable methodologies to reflect the DG effects at the transmission level. This work will feed directly into SQSS working group on alignment of SQSS with P2/6 .

- The project will also facilitate better commercial and technical interaction between TSO/DNO for now, and between TSO/DSO in the future.

- By better modelling embedded generation contribution to load profile at GSPs, the issues currently affecting National Grid in terms of voltage and reactive power management (i.e. High Voltage at Night Time), can be rectified. Better solutions therefore can be recommended i.e. Widening the reactive power range at the GSPs (through interaction with relevant DNO).

Please provide a calculation of the expected benefits the Solution

Research Project - Not required

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

This project is applicable to thw whole of the National Grid Transmission system.

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

The learning will be bought back into NGET and developed further. This cannot be rolled out to the Transmission system in its current format.

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 learning that will be generated could be used by relevant network licenses due to this project aiming to reduce load forecasting errors, which in turn will reduce the level of operational reserve. Essentially, this will lead to improved balancing efficiency and carbon efficiency.

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.

Having checked our standard supply base, including Universities, EPRI and the ENA Smart portal, National Grid confirm that this work has not been done before.

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