

NIA Project Registration and PEA Document

Date of Submission

Sep 2016

Project Reference Number

NIA_NGET0193

Project Registration

Project Title

Project DESERT (hybrid battery and solar enhanced frequency control)

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NIA_NGET0193

Project Licensee(s)

National Energy System Operator

Project Start

September 2016

Project Duration

1 year and 7 months

Nominated Project Contact(s)

Lilian Macleod

Project Budget

£500,000.00

Summary

- Optimise operating characteristics for battery storage and solar PV to provide enhanced frequency response and the response distribution between battery and solar PV
- Coordinate response with high ramp rate (solar) that can cause high system volatility with a battery that can provide a sustained response if required
- Demonstrate additional reactive power support from battery storage; absorption of overnight reactive power or during high PV output
- Outcomes to be coordinated with the EFCC project to better realise the innovative control system coordination with other resources. Further, the alignment with the EFCC project will enhance the objective of development of a specification for a new commercial system balancing service to assist the GB system operator in being able to securely operate the system in a future with high levels of non-synchronous generation.

Third Party Collaborators

BELECTRIC GmbH

Nominated Contact Email Address(es)

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Problem Being Solved

In Great Britain the transmission system frequency is nominally 50Hz and the System Operator caters for various imbalances caused by changes in demand or generation to maintain the frequency in accordance with the National Electricity Transmission System Security and Quality of Supply Standard (NETS SQSS). However, the lower the system inertia (due to the increased connection of more converter based technologies and reduction in large thermal generation plant), the more susceptible a transmission system is to a higher rate of change of frequency (RoCoF) following the loss of a significant volume of generation or demand. An increase in the speed and volume of frequency response available would mitigate against this susceptibility.

At the end of 2015 it was anticipated that solar PV would contribute 9.6GW of installed capacity by 2020. National Grid's Gone Green energy scenario indicates solar will reach approximately 20GW by 2020. As the volume of intermittent generation sources grows, the demand seen by the transmission system will become increasingly volatile and pose challenges in predicting demand and therefore operation of the transmission system. In addition to managing the system with increasingly volatile periods of transmission demand, solar PV is connected to the system via power electronics and therefore does not provide inertia. This contributes to reducing system inertia necessitating increased frequency response to be held by the System Operator. Historically to operate the system in low demand periods, generation is constrained and interconnector imports restricted. However, as a greater proportion of generation is supplied from intermittent sources, more frequency response will be required from alternatives to conventional generation.

An alternative approach is to combine solar PV with battery storage. This will allow storage to be used to better regulate or smooth the transmission demand profile or be used to provide response during periods of rebalancing as other conventional plant ramps up to provide a sustained response to maintain frequency within limits.

Use of batteries would offer the flexibility either to reduce the effective generation contribution to the distribution system, or to provide additional fast response to support frequency containment under high RoCoF events, offsetting the reliance upon the natural inertia of (slower responding) conventional generation.

Method(s)

Belectric are planning to install a 1MW/1MWh battery storage unit at the Rainbows solar PV site (3.8MWp, near the village of Willersey) in Gloucestershire. They have agreed to permit National Grid to undertake an agreed set of trials to investigate frequency and voltage provision from hybrid solar PV and battery storage.

Belectric are a partner in the EFCC project, and the trials being undertaken within the scope of this NIA project will make use of the monitoring and control system being developed by GE Grid Solutions offering efficient leverage of work already underway. This monitoring and control system detects a specific Rate of Change of Frequency (RoCoF) and utilises local and wide area measurement to initiate a proportionate frequency response. For optimum efficiency this project will be managed alongside existing EFCC work streams.

Scope

- Optimise operating characteristics for battery storage and solar PV to provide enhanced frequency response and the response distribution between battery and solar PV
- Coordinate response with high ramp rate (solar) that can cause high system volatility with a battery that can provide a sustained response if required
- Demonstrate additional reactive power support from battery storage; absorption of overnight reactive power or during high PV output
- Outcomes to be coordinated with the EFCC project to better realise the innovative control system coordination with other resources. Further, the alignment with the EFCC project will enhance the objective of development of a specification for a new commercial system balancing service to assist the GB system operator in being able to securely operate the system in a future with high levels of non-synchronous generation.

Objective(s)

- Innovative command and control schemes will be implemented that enable the battery to respond to external control signals.
- Demonstrate how battery storage can best be coordinated to provide an optimised response across a range of resource providers.
- Optimise the capability of battery storage and solar PV power plants in delivering grid services on different levels.
- Support the development of performance requirements in parallel with EFCC (NIC) project for roll out of a new balancing

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project is successful if we improve understanding of

- Availability of batteries for enhanced frequency response with solar PV including impact on OPEX costs
- Potential market share of battery storage and solar PV in ancillary service market
- Site specific benefits and limitations of enhanced frequency response as well as for voltage stabilisation
- Potential contribution of battery storage combined with renewables towards the availability and volume of frequency response, reactive power support

Project Partners and External Funding

Belectric will be contributing approximately £500k associated with the cost of the battery storage unit. Willersey (Rainbows) was constructed by Belectric who also operate and maintain the site. Ownership is shared by the community.

Potential for New Learning

- The response capabilities of new technologies are not currently being fully utilised. With the increase in the amount of renewables connected to the GB electricity system, it is vital that a more diverse range of resources are able to contribute to system stability in a more economic and efficient way.
- This will be the first time a battery, based on lead-acid technology (which is significantly cheaper than Li-ion) will be used as a standalone frequency response unit in GB. The size of the project (1MW/1MWh battery and 3.8MWp solar plant allows demonstration of services for transmission level
- Potential for knowledge of the capability of batteries and solar PV power plants in delivering grid services on different levels.
- The financial benefits of operating a battery in the plant will be studied and the development of a future commercial policy for battery storage and solar PV operation will be outlined. This will provide a vital new tool for National Grid as we continue to manage the GB system.
- Allow a fuller assessment of the potential for greater competition in frequency response service provision that can inform other Transmission Licensees.

Scale of Project

The project encompasses

- 18 months
- NGET project support, coordination with Belectric and other EFCC project partners.
- Costs for design engineering, operational and maintenance costs, modification of IT systems to coordinate both additional the solar PV and battery technologies ,engineering resource for testing and estimated costs for travelOther battery related options have been assessed and found that they would not provide the same increased learning potential that is being sought through combining solar PV plus battery storage (battery only options), or initial investigations indicated that the ≤ 500 ms target response times could not be achieved.
- Further a key objective is to align the outcomes with the EFCC project to maximise the benefits of the project.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

Willersey (Gloucestershire)

Revenue Allowed for the RII Settlement

None

Indicative Total NIA Project Expenditure

The indicative NGET NIA expenditure for this project is £500,000.

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)

Potential consumer saving of **£38m-£59m** attributable to solar PV/battery storage hybrid by 2020 based on future additional enhanced frequency response requirements has been carried out as part of National Grid's 2015 System Operability Framework and existing frequency response service payments.

Please provide a calculation of the expected benefits the Solution

The original EFCC proposal requested £1.12m to acquire a new Belectric 1MW battery unit which would lead to a potential benefit (return) of at least 33% for consumers.

The cost of this proposal is to undertake trials only at a solar PV/battery storage site, therefore realising a potential benefit of at least 88% for consumers.

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

This application could be replicated across solar PV plants across GB. The proposed trial is for 3.8MW solar farm and 1MW battery. Solar farms in the development and planning stages of 4MW or greater From Solar Deal Tracker, IHS 2015 there are over 925 solar farms (either operational or in development) of 4-5MW and above. The outcomes of the operational trials will directly inform the capability and availability considerations in the development of the new commercial service being developed as part of the EFCC project (March 2018)

The project cost included for the trial period includes,

- engineering design for hybrid control system development and integration with EFCC (other service providers)
- operation and maintenance and insurance
- modification of IT systems and installation and testing of communications,
- operational trials
- estimated cost of commercial service during the project (Belectric will not be able to provide existing frequency response services)
- Contingency (£70k) to cater for additional site specific equipment to synchronise the response between the solar PV and battery

storage technologies as well as decommissioning activities.

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

The entire cost of rolling out the proposed method will be evaluated during the project and in parallel with the EFCC (NIC) project.

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

Learning will inform future NGET and DNO approaches across future control activity. Learning will further inform DNO on the range of control specification of demand and embedded generation that may support improved demand control characteristics. Finally both DNOs and NGET will benefit from the development of improved voltage dependent load modelling which results from this project.

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 addresses the Frequency Containment challenge identified in the System Operability Framework which is included in the SO priority innovation theme of operating the system with high levels of non-synchronous generation.

- 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.

National Grid has reviewed the ENA's smarter network portal and liaised with the other GB electricity networks to check for potential

duplication. We have identified that Western Power Distribution are undertaking a project (NIA_WPD_004) that involves a similar principle of combining storage with solar PV. The National Grid team involved in developing this project have reviewed the details of the WPD project and discussed both projects with WPD to check that no unnecessary duplication occurs.

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