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

Sep 2018

Project Reference Number

NIA_NGTO019

Project Registration

Project Title

Unlocking Transmission Transfer Capacity

Project Reference Number

NIA_NGTO019

Project Licensee(s)

National Grid Electricity Transmission

Project Start

May 2018

Project Duration

1 year and 7 months

Nominated Project Contact(s)

Xiaolin Ding

Project Budget

£171,370.00

Summary

It is proposed to investigate the use of Energy Storage systems to economically unlock the inherent transmission network capacity. Strategic locating and sizing of storage resources will allow the network operators to load the network to a synthetic N-0 capacity, and when necessary to utilise the strategic storage resources to absorb/inject power post contingencies up until a system re-dispatch is affected.

Nominated Contact Email Address(es)

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Problem Being Solved

Transmission systems are designed to interconnect generation and load areas, while meeting a stringent set of reliability criteria. In order to maintain the level of reliability expected from our stakeholders it is necessary to have spare capacity in the networkin anticipation of potential contingencies that may exceed the system's thermal, voltage, or stability limits. Maintaining this level of reliability requires investment as the distribution and volume of generation and demand changes.
These prudent operational restrictions, dictated by the capability of the conventional systems that make up transmission networks, can have significant economic costs to many stakeholders.

Method(s)

Unlocking built-in network capacity is a major opportunity for consumers and network licensees. It is proposed to investigate the use of Energy Storage systems to economically unlock the inherent transmission network capacity. Strategic locating and sizing of storage resources will allow the network operators to load the network to a synthetic N-0 capacity, and when necessary to utilise the strategic storage resources to absorb/inject power post contingencies up until a system re-dispatch is affected.

Constraint payment due to congestion is typically spread across hundreds of hours in a year depending on the fluctuating economics and quantities of energy production facilities and demand resources. Congestion relief has a diminishing return whereby the first MW of capacity increase will have the highest economic value while the last MW will have the least. Sizing energy storage systems will necessarily optimise the trade-off between congestion relief benefits and storage system cost.
The study will examine the key bottlenecks in the GB network and investigate the strategic locations and sizes of storage facilities that

can unlock an increasing level of the network's inherent transfer capacity.
Congestion areas that restrict the transfer of renewable energy are of particular interest due to the added benefit that energy storage systems can provide for frequency and voltage regulation. The study would then lead on to technical specifications of the measurement architecture to be used.

Scope

The project will focus on demonstrating the effectiveness of the concept on two of National Grid's Electricity Transmission System boundaries. The system boundaries could potentially be selected based on voltage level (132 kV-400 kV) and type of system boundary (local – regional). The scope of work will include the following Tasks:

Task 1 – Conduct Siting and sizing analysis of Energy Storage Systems (ESS)

Objective: Select optimal sites and sizes of energy storage systems to address the two system boundaries.

i)Detailed siting and sizing of ESS for the identified transmission boundaries.

ii) The designed energy storage systems will be simulated within the grid model to ascertain its efficacy in resolving the boundary constraints.

Task 2 – Conduct techno-economic study of selected energy storage systems (ESS)

Objective: Conduct a techno-economic study of the selected ESS

A lifetime techno-economic study will be conducted to compare the financial merits of the storage solution relative to the conventional solution. The analysis will consider storage capacity fading and augmentation, asset management cost, losses, replacement, and disposal. The cost of the storage solution will be compared to the conventional solutions.

Task 3 Investigation of a potential ESS control system

Objective: To review current relevant measurement systems in use and future ones under development by National Grid, to determine their potential suitability for controlling an ESS

and provide a high level outline of architecture and measurement needs for the ESS control system including a high level cost estimates.

Task 4 Project Completion and Recommendations for Further Investigative Work

Objective: To summarize the findings of this project and recommend further work necessary to realise an ESS on the GB Network that would economically unlock the inherent transmission network capacity of the two boundaries selected.

Objective(s)

Objectives:

1. Review grid boundaries and select two candidate studies.
2. Select optimal sites and sizes of energy storage systems to address the two system boundaries.
3. Conduct a techno-economic study of the selected ESS.
4. To review current relevant measurement systems in use and future ones under development by National Grid, to determine their potential suitability for controlling an ESS.
5. Recommend further work necessary to realise an ESS on the GB Network that would economically unlock the inherent transmission network capacity of the two boundaries selected.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

This project will be deemed a success if:

- The potential benefits from using energy storage to unlock transmission capacity are understood.
- The costs of using energy storage to unlock transmission capacity are understood in more detail.

Project Partners and External Funding

n/a

Potential for New Learning

This project has the potential to provide the following:

1. A clear view of how energy storage could be used to unlock transmission capacity from the network and how many of the potential benefit avenues can be supplied from a single asset.
2. An assessment of what benefits can be provided to network licensees and the costs of implementing such systems.
3. A list of potential risks and opportunities from this type of network re-enforcement.

Scale of Project

This initial feasibility study was chosen to be this scale to answer key assumptions around the performance and costs of using energy storage to unlock transmission system capacity. A larger project is not currently required, until the fundamentals of how these systems would operate are understood.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

Desktop based.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£171370.00

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)

A constrained boundary is typically costly to rate payers because it limits the economic transfer of less costly energy to consumption centers forcing the substitution with a more costly energy. Congestion cost varies by location and time, but can run in the hundreds of millions of pounds. Additionally, the network's limitations restrict the use of clean energy resources and thus prevent customers from enjoying their environmental benefits.
There is an opportunity for transmission system upgrades to be significantly reduced in cost by using energy storage, as well as an opportunity for system upgrades to be constructed in a significantly shorter period of time; this could reduce the total that consumers are paying on constraints during the construction of a transmission system upgrade.

Please provide a calculation of the expected benefits the Solution

A cost benefit is difficult to perform with high confidence, without knowing the specifics of the boundary that is going to be upgraded. There is opportunity for the 'wire-less' transmission system upgrades to provide significant savings to consumers; however this is difficult to determine without a detailed study.

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

The Electricity Ten Year Statement 2016 report shows tens of transmission boundaries that are constrained by economic or security criterion. This study will be highly replicable to the study of all these boundaries.

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

The development of network upgrade solutions that use energy storage, rather than passive components, could be done by any licensees presently. There would likely be a requirement to develop knowledge within each licensee's company, to allow these technologies to be used easily, as well as the standardization of models and procedures to evaluate benefits that can be obtained from energy storage. This would likely cost around £5million across the entire GB network.

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 planning studies that will be conducted, the interactions with stakeholders, and the study reports will provide ample learning opportunities to system planners to gain the comfort necessary to evaluate the use of energy storage as a transmission or distribution asset.

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 fits within the (chose from below) value area of the Electricity Innovation Strategy:
Efficient Build - Building new assets faster and at lower capital and whole-life costs
Service Delivery - Developing new service-based propositions and business models
☑ 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.

The topic of using energy storage to support the network has been researched previously. Studies have been undertaken to prove that the storage technology is capable of providing the required performance to deliver system services; These studies also took place more than 4 years ago. However, these studies research the fundamentals in more detail and do not assess the technology in a real world environment.

Similar studies are:

http://www.smarternetworks.org/project/ifi1102
http://www.smarternetworks.org/project/prj_1386

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

The project will aim to evaluate the option of energy storage for addressing the transmission boundary constraints in terms of cost and technology. The technology has a great potential to bring the value for the customers subjected to a successful business case. The similar project has not been tried before because of the associated cost and technological risks. However, the cost of energy storage solution is reducing and there is advancement in technology to make it more acceptable for the large scale deployment.

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

There is an uncertainty about the business case for the concept of using energy storage for addressing the transmission boundary constraints.

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

There is a commercial risk as there is no proven business case for addressing the transmission boundary constraint using energy storage. The NIA funding offers the most appropriate route for NGTO to evaluate techno economic aspects of this solution.

This project has been approved by a senior member of staff

☑ Yes