NIA Project Registration and PEA Document

Date of Submission

Aug 2015

Project Reference

NIA_NGET0169

Project Registration

Project Title

Transmission Network Topology Optimisation

Project Reference

NIA_NGET0169

Project Licensee(s)

National Grid Electricity System Operator

Project Start

September 2015

Project Duration

0 years and 8 months

Nominated Project Contact(s)

Anna Blackwell

Project Budget

£150,000.00

Summary

The scope of this project is intended to investigate the feasibility of using existing developed algorithms to establishing network topology changes for the GB NETS and determining if the proposed solutions are practical and valuable in optimally planning the system.

This will consist of the following steps:

1. NGET Identification of historic test cases where thermal constraints have been active

2. Analysis of the historic test cases to identify potential topology changes that could reduce constraint costs

3. NGET analysis of each of the topology changes to confirm operating criteria is maintained and asses the change in constraint costs of adopting the topology change

The proposed solutions will be used as a starting point to optimise the network to reduce the requirement for balancing actions.

Nominated Contact Email Address(es)

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Problem Being Solved

National Grid Electricity Transmission (NGET) is responsible for balancing the GB National Electricity Transmission System (GB NETS) on a continuous basis. The costs to carry out this role are passed through to users of the system via Balancing Services Use of System (BSUoS) charges.

One of the key cost components of BSUoS is constraint costs, where the GB NETS is unable to transmit power required to the location of demand due to congestion at one or more parts of the network. NGET will take action in the market to increase and decrease the amount of electricity at different locations on the network. This could be by entering balancing services contracts, trading or taking actions in the Balancing Mechanism.

The need to take action and the volume of electricity being increased and decreased can be influenced by switching the network to optimise flows on transmission circuits. However the network needs to be optimised to accommodate a changing generation and demand profile over the day and deal with the potential loss of any piece of the system.

As the electricity generation mix changes the GB NETS is becoming increasingly complex and network optimisation is becoming more time and resource consuming, requiring more frequent changes due to the increasing amount of new intermittent renewable generation. The current methods of optimising the network are based around historic solutions and engineering knowledge of a system that is rapidly changing. Alternative methods of identifying optimised network configurations in a timely manner that offer an alternative to balancing actions are required to meet future system needs.

Method(s)

We propose a feasibility study based on algorithms that have been developed during research by a consultancy company in partnership with Boston University and USA transmission organisation PJM. The study will investigate if the existing algorithms can be applied to the GB NETS to provide network configurations to build an optimised operating plan and reduce balancing actions.

The study consists of two separate stages. This proposal covers all stages of the work, although a decision will be made at the end of Phase 1 as to the appropriateness of continuing into Phase 2 based on the feasibility and results of Phase 1.

As the feasibility study is based around utilising algorithms derived in research projects on the US transmission network, National Grid has invested resources into establishing the compatibility of the algorithms with existing NGET network modelling software to ensure that Phase 1 can start in a timely manner. This work has been undertaken prior to the start and registration of the project at NGET cost and is expected to be complete by September 2015.

Phase 1 – Initial analysis of historic conditions with fixed dispatch. Transmission network topology change options to relieve congestion will be identified for five historic snapshots and the resultant change in generation dispatch compared to actual generation changes. This is expected to be done from September to November / December 2015.

Assuming Phase 1 provides suitable topology solutions, the study will progress to Phase 2.

Phase 2 –Pricing impact analysis of topology control and generation dispatch for historic snapshots. This phase builds on Phase 1 introducing market models to fully understand the market impact of changing the network topology, considering changes in generation despatch that are feasible as a result of the topology changes. Should Phase 1 not provide positive results, Phase 2 will not progress, reducing the costs by around £60k.

Scope

The scope of this project is intended to investigate the feasibility of using existing developed algorithms to establishing network topology changes for the GB NETS and determining if the proposed solutions are practical and valuable in optimally planning the system.

This will consist of the following steps:

1. NGET Identification of historic test cases where thermal constraints have been active
2. Analysis of the historic test cases to identify potential topology changes that could reduce constraint costs
3. NGET analysis of each of the topology changes to confirm operating criteria is maintained and asses the change in constraint costs of adopting the topology change

The proposed solutions will be used as a starting point to optimise the network to reduce the requirement for balancing actions.

Objective(s)

The objective of phase 1 of the project is to investigate if it is feasible to use the existing algorithms developed for use with the PJM

transmission system to propose topology changes that can be used by engineers within operational planning to optimise the GB NETS and provide recommended actions to the Control Room.

The continuation of the study into phase 2 will depend on the outcome of phase 1 and, as a relatively short project, the outcome may lead to further detailed developments.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The ability to utilise the existing algorithms to identify changes to network topology that can be utilised to reduce constraint costs by avoiding potential electricity market actions. Topology changes should be credible and in line with existing operating criteria.

Phase 1 will be consider a success if the existing algorithms can be used with the existing NGET transmission models to identify credible alternative network topology that can be used as a starting point to study the transmission network and reduce the requirement for balancing actions and reducing constraint costs, based on fixed generation.

Phase 2 will be considered a success if the algorithms provide both credible topology and the market impact of revised generation despatch.

Similar assessments across the PJM transmission region in the USA have identified improvements of 5 – 10% in the thermal capacity across critical network boundaries. If similar improvements were identified on GB NETS thermal constraint boundaries it is anticipated that constraint costs savings could be of the order of £1 - £5m.

Project Partners and External Funding

None

Potential for New Learning

National Grid is undertaking this feasibility study to investigate if the existing algorithms developed by the consultancy firm, PJM and Boston University can be applied and offer value to the economic operation of the GB NETS.
If successful the proposed topology changes will be used to optimise the GB NETS in planning timescales and reduce market actions required.

Scale of Project

This is a feasibility study to confirm that existing algorithms can be used with the existing NGET network planning tools to establish solutions are practical and valuable in optimally planning the system.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The study could apply across all of the GB NETS however the initial snapshots are likely to be concentrated across areas on the NGET network in England & Wales where thermal constraints have historically occurred.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

The indicative total NIA budget for both phases is £150k. This is based on initial price range due to on going work confirming the compatibility between the existing algorithms and the NGET transmission model.

If the project is halted at the end of Phase 1 it is anticipated that the total cost will be approximately £80 - £90k.

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 savings will arise if the feasibility study indicates that alternative network topology solutions can be identified that offer an alternative to balancing actions and meet existing operational criteria.

Please provide a calculation of the expected benefits the Solution

Phase 1 is a research feasibility project which is anticipated to move the TRL from 2 to 3.

Financial benefits for Phase 2 will depend on the success of Phase 1.

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

If this method proves feasible based on the historic snapshots within England & Wales the method can be applied across the GB NETS.

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

The cost of rolling out this method across GB are currently not known and will be dependent on the outcome and recommendations of the feasibility 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

n/a

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.

To the best of our knowledge there are no other projects investigating methods of providing network topology changes to optimise the transmission system and reduce constraint cost actions.

By utilising existing algorithms developed to operate on part of the US transmission network, this project is building on work that has already been researched and developed.

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