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

Feb 2014

Project Reference Number

NIA_NGET0105

Project Registration

Project Title

Enhanced Weather Modeling for Dynamic Line rating (DLR)

Project Reference Number

NIA_NGET0105

Project Licensee(s)

National Energy System Operator

Project Start

August 2013

Project Duration

3 years and 1 month

Nominated Project Contact(s)

Anna Blackwell

Project Budget

£233,000.00

Summary

This project aims to establish the spare thermal capacity in overhead lines that exists as a result of the actual weather parameters compared to seasonal values, and forecast the capacity that will be available ahead of real-time. As such, operational decisions will be able to be made which will reduce the cost of operating the system and potentially avoid or defer reinforcement works following the connection of new low carbon generation.

The project is being undertaken in partnership with Scottish Power Energy Network (SPEN), the University of Strathclyde and the Scottish Energy Technology Partnership (ETP) and builds on the IET Innovation Award-winning work undertaken with SPEN at the University of Durham and the LCNF tier 1 project (SPT1001).

The scope of the project is to explore how Dynamic Line Rating (DLR) can be more widely exploited within various timescales, utilising historic weather data to estimate prevailing capacity along overhead line routes to establish:

- The suitability of applying to a variety of short term capacities,
- How to utilize DLR in longer timescales to make investment or operational planning decisions such as reinforcement works or contracting strategy,
- Investigate suitable risk factors to apply to forecast ratings at different timescales based on predictability of the weather forecasts ahead of real time.

Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

Problem Being Solved

The electricity market provides a power flow 'solution' to meet forecast GB demand ahead of real time. The GBSO models the market solution taking account of the capacity limits of the transmission system, when the power flow pattern is such that the capacity limits will be exceeded, the GBSO is required to take action to constrain the market solution, at cost to BSUoS customers.

With a change in generation patterns, with increased renewable energy being installed in different location to carbon plant, the system is changing and more GBSO interventions are required, becoming increasingly expensive and time consuming.

The conventional means of reducing the volume of actions would be to reinforce the transmission system at high cost and long lead times. For some circuits an alternative could be to enhance the capacity of existing assets based on real ambient conditions rather than the seasonal, worst case values that are traditionally used to define the asset capacity.

Overhead line capacity is very dependant on the ambient weather conditions, in particular wind speed and direction. Recent developments have enabled techniques and devices to be developed to establish the enhanced capacity available real-time, however, to be of real value and reduce the volume and cost of actions, it is important for the GBSO to know what enhancements are going to available ahead of real-time to feed into the GBSO models and decisions.

Method(s)

Research and Development

This research project will investigate existing dynamic overhead line rating methods and forecasting capabilities currently under development around the world and building on the SPEN SPT1001 LCNF project, "Implementation of real-time thermal ratings" to develop a forecast capability based on spatial interpolation of weather station measurements.

The project involves research into the available techniques under development worldwide to calculate real-time and forecast overhead line ratings, improving weather related overhead line forecasts and the nature of the risk related to utilizing rating forecasts of different probabilities of being exceeded.

Scope

This project aims to establish the spare thermal capacity in overhead lines that exists as a result of the actual weather parameters compared to seasonal values, and forecast the capacity that will be available ahead of real-time. As such, operational decisions will be able to be made which will reduce the cost of operating the system and potentially avoid or defer reinforcement works following the connection of new low carbon generation.

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Objective(s)

The objectives for the project include:

- establish the level of confidence that can be attributed to low cost overhead line rating forecasting techniques that predict overhead line ratings sufficiently far ahead of real time to be useful for operational planning decisions.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The following success criteria have been established:

- Complete a comparison of the dynamic ratings methods that are described in published engineering literature and summarising the different features that are apparent from the literature.
- Develop a new statistical forecasting model that addresses wind speed, wind direction and temperature, quantifying the probabilities of particular forecast quantities being exceeded.
- Evaluate the use of enhanced dynamic ratings in particular GB power system contexts

Project Partners and External Funding

This project involves three partners, each providing external funding:-

Strathclyde University; £21,107

Scottish Power Energy Networks; £47,900

Energy Technology Partnership; £25,000

Potential for New Learning

This project will provide learning around the uncertainty and errors in line rating forecasts and the risk of exceeding or failure to utilize assets to full capability.

Scale of Project

This is a co-funded PhD university based project, building on existing learning. The duration of the project has been selected to align with the PhD duration and a student has been identified to carryout the studies.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

Laboratory placed research therefore the project is not applicable to a particular area. The learning has potential to be applied across complete GB electricity system.

Revenue Allowed for the RIIO Settlement

None.

Indicative Total NIA Project Expenditure

NGET NIA project expenditure is £122,000.

SPEN NIA project expenditure is £56,000.

Total NIA expenditure is £178,000

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)

This is a research project, however it is anticipated that savings will be made by establishing available additional overhead line capacity ahead of real-time that will enable operational decisions to be made regarding operating the system at lower cost. In addition reinforcement works on the system can be reduced or delayed.

Constraints are not a constant cost and very much depend on circumstances, however, indicative savings on a specific circuit, when constraining action is require, can amount to between £350,000 & £750,000 a day.

Please provide a calculation of the expected benefits the Solution

Not required for a research project.

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

The learning from this project will delivered within NGET as a solution either applied to enhance existing overhead line rating tools or via synergistic innovative projects (such as NGET's Humber Smartzone) aiming to develop techniques to enhance complete circuit and boundary capacities across the GB network.

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

This project aims to develop a proof of concept, determining forecast ratings together with the forecast uncertainty. It is unlikely that that the outcome of this project will be rlled out in isolation, additional research and development work will be needed to develop appropriate strategies to be applied at a network level (for example NGET's Humber Smartzone project).

An indicative estimate for rolling out a thermal rating forecasting and powerflow management system at a GB network level could be in the region of £30-50m.

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 regarding the forecasting of overhead line ratings will be initially applied within NGET and SPEN but will be applicable to all TOs. The learning should also be applicable to DNO overhead line networks.

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.

This project builds on work already undertaken (via SPEN's SPT1001 LCNF project) to assess real-time overhead line ratings by enabling it to be extended into long-term timescales to ensure timely decisions can be made.

The findings of this project will feed into existing techniques and future developments in enhancing circuit and boundary capacity, such as NGET's Humber Smartzone project.

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