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NIA Project Registration and PEA Document

Date of Submission

Jul 2018

Project Reference Number

NIA_NGTO014

Project Registration

Project Title

Advanced Line Rating Analysis (ALiRA)

Project Reference Number

NIA_NGTO014

Project Licensee(s)

National Grid Electricity Transmission

Project Start

July 2018

Project Duration

2 years and 1 month

Nominated Project Contact(s)

Ben Muncey

Project Budget

£301,790.00

Summary

Current overhead line (OHL) ratings are applied on a seasonal basis and do not consider the geographical location of the assets and associated variances in meteorological conditions. As such, line ratings may be unnecessarily constrained, limiting power flows and prompting unnecessary investment for load related upgrades.

Nominated Contact Email Address(es)

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Problem Being Solved

Current overhead line (OHL) ratings are applied on a seasonal basis and do not consider the geographical location of the assets and associated variances in meteorological conditions. As such, line ratings may be unnecessarily constrained, limiting power flows and prompting unnecessary investment for load related upgrades.

Method(s)

This project will consider the whole of NGET's transmission network (overhead lines only) and assess the variation of thermal ratings between routes throughout England and Wales. The project will also assess the variation of thermal ratings between spans along individual routes.

Climate and terrain models will use historic weather data, recorded from points around the UK, to generate up to 10 year weather history for every OHL span on the NGET Transmission System. This weather data will be calibrated against measured data recorded from NGET overhead line towers. Weather data generated will include Ambient Temperature, Solar Radiation, Wind Speed and Wind Direction.

The generated weather data will enable overhead line temperatures to be calculated at regular frequencies throughout the 10 year period. The variation of calculated conductor temperatures over this period can be assessed and the risk associated with exceeding current operating temperatures can be calculated. Understanding how the risk varies throughout the country will provide a framework and a measure for applying enhanced ratings to certain routes.

Due to the complexity of the model used, and the potential run time, two conductor types will be used to calculate conductor temperatures for all routes. High resolution models will be applied in two different areas of the country (where the frequency of the weather data will be increased). This will allow us to determine whether the resolution of the data is suitably accurate. In addition, all conductor types will be analysed for a subset of routes (circa 500 spans) in each of the high resolution domains to determine whether the conductor type is significant in determining line ratings.

At the start of the project, an optimisation exercise will assess the effects of data resolution on model run time. This will ensure that the quality of the data output by the model is acceptable whilst maintaining reasonable timescales for the overall project.

National Grid will provide the supplier with the following information:

- Tower/route location data,
- Weather data recorded from OHL towers,
- OHL Rating algorithm,
- Conductor details,
- Thermal rating test scenarios.

Scope

The stages of the project will be performed as shown below:

Milestone 1

- Tower data, conductor data, weather data, the ratings algorithm provided by National Grid

Milestone 2

- Installation and successful validation of National Grid's line rating model.
- The available weather data and routes in scope will be reviewed to select initial region(s) for testing.
- The optimum amount of weather data needed to generate reliable line rating data will be determined.

Milestone 3

Summary Report detailing findings from data audit, weather simulation and overall results of data optimisation exercise.

- Long term weather data will be generated for the routes in scope. This will be compared with available weather station data.
- The weather data will be used as inputs to National Grid's line rating calculation code. This will be used to calculate line ratings for each span of each route in scope. The output at this stage will be a time series of line ratings for each span.
- Weather sensitivity analysis will be conducted to assess the impact of weather simulation errors on the final results. This will allow suitable safety factors to be included in the new line ratings.
- Statistical analysis will be used on the time series to calculate a line rating that is suitable for the entirety of each route in scope. This will account for the lowest rated span in each route. Probabilities of exceedances for each span in each route will also be presented.
- Data analytics (e.g. clustering analysis) will be conducted on the larger data set to identify geographical or seasonal patterns.
- The above analysis will be conducted with two simulation setups in order to be efficient with respect to storage space and code runtimes. New static line ratings for each route in scope on a span-by-span basis and a route-by-route basis.
- New static line ratings will be analysed for geographical and seasonal patterns (i.e. can any new rules for static line ratings be applied on a regional or seasonal basis).
- Information that enables NGET to calculate new static line ratings will be provided along with a probability of exceedance. This will give a better understanding of existing thermal ratings and where higher ratings may be appropriate.
- A comparison of the line rating results generated using medium and high resolution weather data.
- A comparison of the line rating results from different conductor types using high resolution weather data.

Milestone 4

Generation of data that allows NGET to calculate new static line ratings and probabilities of exceedance for medium and high resolution zones. Analysis of the impacts of weather resolution and conductor types on line ratings.

Data and Report provided to National Grid. Data provided will be time series data for each span and will include the weather parameter data and the calculated conductor temperatures for all scenarios.

- Any relevant geographical or seasonal patterns. E.g. if all line ratings within a particular region are similar within a tolerance, this will be identified.

Summary Report provided to National Grid detailing geographical and seasonal analysis.

Objective(s)

To reduce the need for load related investment in locations where higher thermal ratings are available due to favourable weather conditions. The scale of this reduction will be determined by the extent to which weather conditions vary dependent on geographical location.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project will demonstrate whether there is benefit in considering geographical location in the application of OHL thermal ratings.

- For each route on the NGET Transmission Network.
- Weather parameter data will be generated for all span locations over the selected time period,
- Conductor temperature data will be generated for all span locations over the selected time period,
- High resolution to be generated for selected spans in designated area,
- The uprating potential of each route will be calculated.

Project Partners and External Funding

N/A

Potential for New Learning

The learning from this project will benefit all network licensees that own/operate overhead lines.

Scale of Project

The work requires engagement of a third party to carry out computer modelling to determine whether the proposal is viable.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

Desk based

Medium resolution weather data (e.g. hourly) will be used to determine line ratings for all routes.

High resolution weather data (e.g. 10-minute interval) will be used to generate data for two geographical areas. This will determine whether the resolution used is of suitable accuracy.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

301,790

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)

Assuming the benefit would be the mid-point between the high and low cases identified below, the initial benefit would be £4.522m over a 13 year period.

Please provide a calculation of the expected benefits the Solution

The Network Options Assessment (NOA) 2017/18 report (January 2018) identifies a load related requirement to reconductor or uprate seven overhead line routes between 2019-2025. Assuming that revising line ratings would allow the reconductoring scheme requiring the least investment to be deferred by at least two years, the expected benefit would exceed the investment required for the project, providing a benefit of £0.028m.

Assuming all four load related investment schemes in the North of England (as identified in the NOA report) could be deferred until the end of their asset life, the expected benefit from the project would be £9.015m.

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

Assuming the other network licensees adopt a similar approach to calculating line ratings then the method could be applied to the full GB transmission system.

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

Any change of approach in determining line ratings will be taken to the internal governance board for acceptance. Assuming that the project yields a successful output then the estimated cost for other network licensees to adopt a similar approach would not exceed the value of this 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 trialed 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 project will determine whether an alternative approach for calculating line rating is viable. This learning could then be utilised by other network licenses who own/operate OHLs.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

Managing Assets - Managing assets throughout their lifecycle

- 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.

There are no known projects being undertaken on the electricity transmission system.

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