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

Jul 2018

Project Reference Number

NIA_NGTO012

Project Registration

Project Title

The application of Parametric Design to automate substation development

Project Reference Number

NIA_NGTO012

Project Licensee(s)

National Grid Electricity Transmission

Project Start

August 2018

Project Duration

1 year and 0 months

Nominated Project Contact(s)

Ben Muncey

Project Budget

£97,000.00

Summary

Civil engineering work makes up a large proportion of the total cost of building electrical infrastructure. Savings made during the design or construction of civil infrastructure can therefore have a huge impact on the cost of network investment. National Grid is striving to develop innovative civil infrastructure solutions which meet the required specifications, while also reducing costs and development times.
Established design processes using Computer Aided Design (CAD) and structural analysis software save some time, but aren't presently flexible enough to allow multiple design options to be explored quickly and efficiently. This project aims to address this deficiency.

Nominated Contact Email Address(es)

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Problem Being Solved

Civil engineering work makes up a large proportion of the total cost of building electrical infrastructure. Savings made during the design or construction of civil infrastructure can therefore have a huge impact on the cost of network investment. National Grid is striving to develop innovative civil infrastructure solutions which meet the required specifications, while also reducing costs and development times.
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Method(s)

Recent developments in design automation using Parametric Design have the potential to deliver savings in the development of new electrical infrastructure projects. The premise of Parametric Design is to automatically generate the layout of the assets based on the rules defined by the technical specifications; rather than an individual designing to the specifications.

Parametric design uses algorithms to generate a hierarchy of mathematical and geometric relations that allow the automatic generation of a new design, while also allowing you to explore the whole range of possible solutions that the variability of the

specifications may allow. The traditional design method only allows one option to be assessed at a time; while Parametric Design will make it easier and quicker to assess different design options and the potential savings that can be achieved.
In other words, parametric design is almost like programming, but for material objects, where you set rules for the design to follow which are based on your design criteria. It is proposed that parametric design can be applied to automate the design process for substation extensions.

Scope

This project will perform a desktop feasibility study into using Parametric Design for a substation extension, which will:

- Define the key design rules which need to be complied with and can be automated.
- Determine any limiting factors which cannot be taken into account or automated.
- Specify the key input data needed for the parametric design process.
- Perform a high-level cost benefit analysis to establish if the approach is feasible and quantify benefit it could bring.

The feasibility study will be delivered in the form of a report detailing the above items.

Objective(s)

- Determine the feasibility of applying Parametric Design to electricity substation design
- Define the design rules which can be applied as parametric rules
- Determine the input data required to facilitate the parametric design and efforts required to collect this
- Establish the overall feasibility (cost, benefit, time saved) of this approach for the design of the electricity substations (both new and modification of existing ones)

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Delivery of report outlining feasibility of the Parametric Design tool when applied to an example substation extension. Outlining the next steps in terms of the data required, and implementation plan to develop this concept into a process to save time/cost on both design and construction.

Project Partners and External Funding

n/a

Potential for New Learning

This study will determine whether it is possible to use parametric design to automate elements of the optioneering process within substation design. The concept will additionally be applicable to other network owners.

We believe that the use of parametric design will:

- Reduce the man-hours spent in the design optioneering process
- Allow designers to focus more time on the more complex interfaces between new and existing equipment
- Provide savings during build and operations phases; due to multiple iterations being created and assessed in less time
- Ensure that designers are consistently deploying industry / sector best practice

Scale of Project

The scope defined is the minimum work required to determine how feasible this design philosophy is.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

Desktop based

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

97,000

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)

The estimated saving is 30% of the design cost with the possibility of achieving much greater savings from optimised construction. Considering only the Front End Engineering Design (FEED) costs for a complex scheme, this could yield a saving of £75k for an individual project. Assuming 40% of development costs could benefit from this approach, the savings could be in the region of £840k pa (based on expected spend in FY18/19). As part of the project, a more detailed cost benefit analysis will be undertaken to refine this figure.

Please provide a calculation of the expected benefits the Solution

n/a

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

Substation design is carried out by all major transmission companies and distribution network operators. The concept of Parametric Design can be applied to the whole GB network with some modifications (i.e. where the design rules may differ and therefore need to be redefined). Other network licensees could adopt the same concept in their design procedures. This could involve developing their own software, software based on their specifications, or adopting and developing the software from this project.

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

The cost will depend upon the design rules and number of pieces of equipment used, however once the tool is up and running for one operator it could be easily expanded to include different assets and alter the design rules. It is estimated that implementing this change across GB would cost around £2million.

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

Understanding the design rules and feasibility of Parametric Design can be used to save time and costs on the design and construction of substations. These pieces of infrastructure constitute significant capital investment in the network, optimizing the layout and the design procedure will likely lead to significant benefits for consumers and the network licensees.

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 Efficient Build value area of the Electricity Innovation Strategy
☑ 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 similar projects being undertaken for the power transmission industry at this time.

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