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NIA Project Registration and PEA Document

Date of Submission

Mar 2024

Project Reference Number

NIA_SHET_0044

Project Registration

Project Title

220kV Single Circuit Low Profile Design

Project Reference Number

NIA_SHET_0044

Project Licensee(s)

Scottish and Southern Electricity Networks Transmission

Project Start

March 2024

Project Duration

1 year and 7 months

Nominated Project Contact(s)

Brant Wilson - Innovation Portfolio Manager
(transmissioninnovation@sse.com)

Project Budget

£1,430,000.00

Summary

There is an increasing need to connect renewable developments with increasing electrical capacity and geographic density. Existing lowprofile, overhead lines (OHL) lack sufficient capacity to accommodate large individual or aggregated electrical capacity. The only current alternatives carry a stepwise increase in construction costs due to their complexity and need for engineered access during construction. The proposed 220kV low-profile designs will provide a lower-cost solution that will assist the energy system transition by reducing the costs of large or aggregated renewable energy connection.

Nominated Contact Email Address(es)

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Problem Being Solved

In the immediate future, Networks must provide connections to multiple renewable developments with increasing electrical capacity and geographic density. Existing low-profile, overhead lines (OHL) lack sufficient capacity to accommodate large individual or aggregated electrical capacity. This subsequently dictates that the only suitable alternatives in the current design suite are steel lattice towers, NeSTS steel poles, or underground cables. Each of these options carries a stepwise increase in construction costs compared to 132kV wood or steel pole designs.

Applications for individual connections are increasing in capacity in response to the scale of generating plants. In addition, for wind farm connections, the geographic density of such developments is increasing, leading to the creation of collection hubs. In many cases, these developments exceed the electrical capacity of wood pole designs leading to cases where multiple OHL are run in parallel to support the proposed load, introducing consenting challenges.

The 132kV Low Profile Pole (EaSTS) design creates some capacity increase however the 220kV designs will provide a solution for

connecting large single point connection windfarms at low to medium altitudes.

Method(s)

Development of two new low-profile pole designs with an operating voltage of 220kV. The first is a wood pole equivalent design with a reliability (level 1) appropriate to non-firm connections, and the second is a design with a reliability (level 2), suitable for applications of the Main Interconnected Transmission System (MITS). Both designs envisage directly embedded steel poles using composite insulators.

Knowledge gained during the development of EaSTS design is expected to be used in this proposal to reduce development time and cost.

To address the need for a further increase in capacity, the technical solution is to increase the nominal operating voltage to a level that meaningfully increases the capacity without the introduction of excessive corona-induced conductor noise. The solution should maintain the construction practices associated with wood poles to keep construction costs in line with the current EaSTS design.

Data Quality Statement (DQS):

The project will be delivered under the NIA framework in line with Ofgem, ENA and SSEN Transmission internal policy. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal SharePoint platform ensuring access control, backup, and version management. Deliverables will be shared with other network licensees through the closedown reports on the Smarter Networks Portal.

Measurement Quality Statement (MQS):

The methodology used in this project will be subject to supplier's own quality assurance regime. Quality assurance processes and the source of data, measurement processes and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and will be made available for review.

In line with ENA's Energy Networks Innovation Process (ENIP) document, the cumulative risk score is scored as 7 = MEDIUM from the sum of the risk thresholds below:

TRL Steps – 4 TRL Steps – Medium (Score 2)

Cost – >£1m – High (Score 3)

Number of suppliers – 2 – Low (Score 1)

Data – Defined assumptions and principles – Low (Score 1)

Scope

The project will be split into three work packages to:

1. Develop prototype designs.
2. Build prototypes and report on performance and subsequent design refinement.
3. Conduct type testing for Technical Authority approval.

Objective(s)

The project objective is to create a 220kV low-profile design which replicates the visual consenting envelope, reliability levels, insulation level, and construction methods associated with wood poles, significantly reducing future construction costs. Application of the low-profile design within the existing design suite as a substitute for current steel structures could provide a significant reduction in construction costs. Lower construction costs will provide customers with lower cost connections and support energy system transition. The 220kV low-profile design will provide higher capacity than the 132kV equivalent, the project aims to develop two designs which achieve reliability level 1 for generation connections, and reliability level 2 for use on the Main Interconnected Transmission System (MITS).

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

An assessment of distributional impacts (technical, financial, and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a positive, negative, or neutral effect on consumers in vulnerable

situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register. This project has been assessed as having a neutral impact, meaning that it does not have any effect on customers in vulnerable situations. This is because it is a Transmission project.

Success Criteria

The project will be deemed as successful if all items in the scope, objectives and learnings are met which can be used to assess the effectiveness of 220kV low-profile steel poles as a suitable alternative allowing an increase in capacity over the 132kV low-profile pole design (reliability level 1 design). The project will also be deemed as successful if the project can deliver a 220kV low-profile pole design which meets the requirements specification to be deployed on the MITS (reliability level 2 design.)

Project Partners and External Funding

The project will be undertaken using NIA funding by Scottish Hydro Electric Transmission supported by contractors Energyline, Norpower, PLPC and Allied Insulators.

Potential for New Learning

- Determine the potential of utilising 220kV low-profile pole designs will provide a solution for connecting large single point connection windfarms at low to medium altitudes.
- Develop a robust cost benefit analysis to demonstrate the potential cost savings by implementing a 220kV low-profile steel pole design.
- Demonstrate how implementing 220kV low-profile steel poles can contribute to energy system transition.

Learnings from the project will be disseminated via internal and external stakeholder events which will be conducted during the project. The learnings will also be shared within the annual project report and at relevant dissemination events such as the Energy Networks Summit Conference.

Scale of Project

This project is designed to get maximum learning for minimal cost. This scale of project expects to provide sufficient learning to fully assess the suitability of implementing 220kV low-profile steel poles in future Transmission projects. Any smaller scale project would limit the ability to fully assess the suitability of the proposed solution.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

The project will be undertaken in the Scottish Hydro Electric Transmission licence area in Scotland.

Revenue Allowed for the RIIO Settlement

No allowance has been made for this type of development within the RIIO-T2 settlement. No savings are expected during project implementation; future savings may be possible depending on the outcomes of the project and future adoption of the created design(s).

Indicative Total NIA Project Expenditure

The total expenditure expected from the project is £1,430,000. 90% of which £1,287,000 is allowable NIA expenditure.

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:

The learnings from the project have the potential to facilitate energy system transition by providing a lower cost OHL, compared to current approved design (lattice towers/NeSTS), enabling lower cost solution for connecting large multi-point renewable generation at low to medium altitudes. These learnings differ from the 132kV low-profile pole design which developed a new design for connecting single point renewable generation at high altitudes over 300m.

How the Project has potential to benefit consumer in vulnerable situations:

Not applicable.

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)

Not applicable.

Please provide a calculation of the expected benefits the Solution

The cost benefit analysis is conducted in order to assess the feasibility of implementing 220kV low-profile poles for transmission network, as opposed to the conventional use of steel towers and wood poles.

There is a 60% saving in construction cost per km of 220kV low profile poles compared to the conventional steel lattice towers.

Although the construction cost per km of 220kV low profile poles compared to the single circuit wood poles would be 33% higher, in the eligible individual projects two parallel single wood pole lines would be required to accommodate the increase in capacity. This means costs will be doubled giving an increase of 50% when compared to 220kV low profile poles.

The construction cost per km is as follows:

- Double circuit 220 kV low profile pole line: £0.8 million per km
- Double circuit steel lattice tower line: £1.98 million per km
- Two parallel single wood pole lines: £1.2 million per km
- Approximately 86km in total from three identified projects and one cluster were analysed. There are three scenarios developed to study the cost variances between 220 kV low-profile poles (Scenario 3) with different combination of steel lattice towers and wood poles (Scenario 1 and 2). The results showed the below range of lifetime cost savings.
- Replacing wood poles with 220kV low-profile poles would lead to a lifetime saving of £17 million at 2018 real values.
- Replacing significant portions of double circuit steel lattice tower with the low-profile poles is expected to result approximately to a lifetime saving of £72.4 million at 2018 real values.

The cost benefits at the end of the RIIO T3 regulatory period are estimated between £2.5 and £9.5 million for all identified lines.

These projects will be carried out through the asset life of the power lines (45 years). The capital budgeting method of Net Present Value (NPV) is used to account for the time value of money and expressed in 2018 real values based on Ofgem's CBA template.

The budget of the 220kV low profile Innovation project to develop the final design is £1.4 million funded by NIA with 10% contribution from SSEN Transmission. This is not deducted from the final cost savings as it is one-off expense and does not represent the cost of the design during the BAU deployment. However, if the cost benefit of the innovation project including Innovation project development cost is required, the £1.4 million (£1.17 million in 2018 real values) should be subtracted from the above reported cost benefits, so the net lifetime benefit value would be from £16.2 million to £71.2 million. This if risk-adjusted would range between £12.7 million and £56.3 million. Benefit values are risk-adjusted considering a 21% risk factor to reflect any changes in timelines, technical constraints, and market price fluctuations.

The cost saving kick starts from the first year of construction of the first eligible line which is 2027. If the innovation development cost is considered as part of the BAU budget, then the breakeven year will be delayed by a year only in Scenario 1. All estimated cost savings represent a direct SSEN Transmission benefit on CAPEX reducing construction costs associated with wood pole and steel lattice towers.

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

The learnings are of interest to Scottish Hydro Electric Transmission due to the geographical composition of our network and the requirements of future connection projects under development. The learnings will be of interest to other licensees who have similar limitations with current approved designs.

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

The costs of rolling out the method across GB are dependent on the operation and geography of the rest of the GB network.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RII0-1 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

Relevant network licensees will be given access to the designs and test results from the project. Should a suitable design(s) be implemented, other licensees can incorporate this design into their own projects where they have similar limitations as detailed in the problem statement.

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

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 date, no other projects have been undertaken to develop a design to address the problem statement.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

Not applicable.

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

The project is innovative as it will develop a new untried design which will be subjected to a product design validation process and is expected to provide a new solution to resolve an ongoing problem.

Relevant Foreground IPR

Any new designs which are completed as part of the NIA project will be made available to other relevant networks licensees. No background IPR is required.

Data Access Details

See Strategic Innovation Fund (SIF) and Network Innovation Allowance (NIA) Data Sharing Procedure at [Innovation - SSEN Transmission \(ssen-transmission.co.uk\)](https://www.ssen.co.uk/innovation-sen-transmission)

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

This is a new design that is yet unproven and needs to be better developed and validated before it can be introduced as business as usual. There are certain risks associated with the design scope which need to be tested first. Due to the low TRL and risks associated with this project, NIA funding is the correct mechanism rather than BAU delivery.

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

This project can only be undertaken with the support of NIA due to the overall costs and timescales required. There is significant technical design work to be undertaken which may demonstrate there is not a suitable alternative solution to current design. There is also commercial risk that costs for a new design carry a significant risk until a draft design can be costed and a cost benefit analysis review. NIA is the best mechanism to fund development projects such as this.

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This project has been approved by a senior member of staff

Yes