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## NIA Project Registration and PEA Document

### Date of Submission

Feb 2023

### Project Reference Number

NIA\_SHET\_0040

## Project Registration

### Project Title

Corrosion Mapping

### Project Reference Number

NIA\_SHET\_0040

### Project Licensee(s)

Scottish and Southern Electricity Networks Transmission

### Project Start

February 2023

### Project Duration

1 year and 3 months

### Nominated Project Contact(s)

Brant Wilson

### Project Budget

£300,000.00

## Summary

To understand the impact of corrosion on galvanised steel assets in the North of Scotland, SSEN Transmission utilise the Galvanisers Association corrosion map. This map provides the atmospheric corrosion rate of hot dip galvanizing on a 10km grid, which is applied to estimate the average life of assets. The science behind how the map has been developed is not fully referenced and is not understood to consider topography or industrial pollution. In addition, the 10km grid does not provide adequate resolution to make informed decisions on specific assets/asset locations. This lack of granularity results in overly conservative technical decision making.

The project will develop a new corrosion map which will be compared against the Galvanisers Association map to assess potential benefits of adopting new design and lifecycle practices.

### Nominated Contact Email Address(es)

transmissioninnovation@sse.com

## Problem Being Solved

The rate of deterioration of SSEN Transmission's assets by environmental induced metrological corrosion is currently estimated using the information provided by the Galvanisers Association Map. The methodology supporting the existing map has been superseded by modern meteorological practice and thus provides insufficient confidence for current strategic decisions to be taken. Examples would be the need for substations to be enclosed in proximity to coastal environments and the estimation of the remaining conductor service life of existing overhead lines. These limitations are further exacerbated by the limited granularity of the map, which does not sufficiently account for local topography and orography, which can significantly affect the presence and persistence of airborne environmental pollutants. Consequentially, overly conservative technical decision-making processes are invoked, which do not represent the optimal business decisions.

## Method(s)

SSEN Transmission will partner with the Met Office in this project. The Met Office will:

- Review the current methodology that was used to develop the Galvanisers Association corrosion map and any standards that SSEN Transmission must comply to when considering corrosion.
  - Conduct a literature review to look at how different factors e.g. wind direction, coastal conditions, pollution, etc. affect the corrosion rate of galvanised steel.
  - Develop a high-resolution climatology of the meteorological variables identified required for corrosion modelling. The high-resolution climatology will cover SSEN Transmission's license area and will be developed at multiple levels. The climatology dataset will be developed using high-resolution Numerical Weather Prediction (NWP) hindcast data from the Met Office archive. This data is at a 4 km horizontal resolution and is based on ERA-interim reanalysis (1979-2015).
- Following the above method, a new corrosion map will be developed and compared against the Galvanisers Association map to assess whether adopting the new map into asset design and lifecycle practices will facilitate more technically efficient decisions reducing capital and/or operating costs

## Scope

The development of the corrosion rate map will be carried out in partnership with the Met Office split into the following distinct work packages:

Work package 1 –Discovery phase

- Requirements workshop
- Literature review
- Technical report & presentation

Work package 2 – Data retrieval

- Extract relevant meteorological data e.g.:
  - o High-resolution Numerical Weather Prediction (NWP) hindcast data from the Met Office archive. Note that this refers to the Met Office's Unified Model high-resolution model for Europe at 4km horizontal resolution, which is based on ERA-interim reanalysis (1979-2015).
  - o Meteorological observations from the Met Office synoptic stations database, as well as any additional third-party observations data and engineering information that are critical for model development, such as route shapefiles and heights.

Work package 3 – Corrosion model development

- Compute the corrosion rates dependent on the relevant meteorological and topographical variables.
- Verification analysis of the corrosion rate model based on case study events. This will be selected with the help of SSEN Transmission and based on sufficient observational data available from which to compare against.
- Corrosion rate model workshop to discuss refinements based on verification output.
- Report outlining corrosion modelling methodology and verification results.

Work package 4 – Application

- Apply developed corrosion model to the high-resolution datasets of the relevant variables across SSEN Transmission's license area.
- Produce a corrosion rate map covering SSEN Transmission's license area.

The final output of this project will be a map and data covering SSEN Transmission's operating area, providing a visualisation tool to analyse corrosion rates.

## Objective(s)

The main objective of the project is to assess whether replacement of the Galvanisers Association corrosion map with new corrosion rate values derived from the application of state-of-the-art NWP values and revised corrosion model would benefit customers.

## 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 successful if the numerical outputs and new learning provide a new cost-effective and reliable alternative to current asset design & lifecycle processes.

## Project Partners and External Funding

SSEN Transmission will partner with the Met Office to deliver Corrosion Mapping using NIA funding.

## Potential for New Learning

The development of the new corrosion map will inherently develop new learning. Principally, this will be in the areas of corrosion rate modelling, and specifically around:

- Increasing the granularity of the corrosion rate map using NWP hindcast data from the Met Office archive
- Methods to include topography and orography
- Methods to include industrial pollution

The new learning will form part of the final report, which will be shared with all relevant parties and will also be presented in postproject dissemination sessions. The methodology could be utilised by other licensees with data from their own geographical areas.

## Scale of Project

This project is designed to get maximum learning for minimal cost. Estimates indicate potential cost savings of £1.81m per substation if Corrosion mapping could demonstrate that not all substations need to be housed indoors when in close proximity to the coast, as defined in SSEN Transmission's design standards. Any smaller scale project would not allow the learning outcomes to be achieved.

## Technology Readiness at Start

TRL3 Proof of Concept

## Technology Readiness at End

TRL6 Large Scale

## Geographical Area

The project will take place in SSEN Transmission's license 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 the future adoption of the learnings.

## Indicative Total NIA Project Expenditure

The total NIA Expenditure for the project is £300,000, 90% (£270,000) 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 project will assess whether, by providing more accurate and relevant weather and environmental data, a more efficient and cost-effective process could be used to design, construct, and maintain SSEN Transmission network assets in the North of Scotland. Reducing the resultant costs associated with renewable energy transmission could assist in the SSEN Transmission RIIO-T2 business plan goal to transport the renewable electricity that powers 10 million homes, contribute to national Net-Zero targets, and provide benefit to customers.

#### 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 analysis will endeavour to cover most aspects of the SSEN Transmission geographical area in Scotland and will assess projects due for design and construction. Any reduction in design capability (removal of overdesign) could therefore result in significant cost savings for customers.

The new corrosion map is expected to eliminate the need for substation assets located within close proximity of the coast to be placed indoors. Based on the identified benefit of £1.81m per single substation, an analysis of the scaled benefit was conducted to reflect the applicability of this innovation to the most recent SSEN Transmission substation pipeline.

Substation design is a complex process with widely varying inputs. Construction costs vary by project; however, indicative costs are used for the purposes of this Cost Benefit Analysis (CBA). From the 14 substations under development currently considering the construction of buildings based on the current conservative map, it is assumed an application rate of 50%, therefore 7 substations only are expected to be susceptible to corrosion with the new, more accurate method. The remaining 7 substations will have the potential to be installed outdoors.

The potential benefits have been calculated as follows -

- Base cost for an indoor substation: £7.44m
- Method cost without indoor substation: £7.44m - £1.81m = £5.63m

- Scaled cost savings: £1.81m per substation \* 7 applicable substations, resulting in total benefits of £12.67m

These projects will be constructed in different timelines in the future, starting after 2025 and have a lifespan of 45 years. The capital budgeting method of Net Present Value is used to account for the time value of money accounting for inflation, discount rate, cost of capital and depreciation are all expressed in 2018 real values based on Ofgem's CBA template. Subject to these assumptions, a reduction in construction costs could result in benefits of £3m by FY 2030/31 in 2018 real prices, if applied to the current projects in the SSEN Transmission area. Further benefits would then be realised by future projects out with RIIO-T2 and T3. The short-term benefits on key regulatory milestones are estimated as below for the seven substations identified.

- RIIO-T2 (FY 2025/26): £476k
- RIIO-T3 (FY 2026/27 – 2030/31): £2.5m

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

The method will be relevant to Scottish weather and environmental conditions, hence, how relevant it is across GB will depend on the geographical location of the other Transmission Network Licensees' systems. The base learning could be replicated across GB with substitution of localised weather data.

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

The costs of replicating corrosion maps for the rest of GB are not fully defined. The costs would be dependent on the size of each geographical area and would be negotiated directly with the developer.

### 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

The development of the new corrosion map will inherently develop new learning. Principally, this will be in the areas of corrosion rate modelling, and specifically around:

- Increasing the granularity of the corrosion rate map using NWP hindcast data from the Met Office archive
- Methods to include topography and orography
- Methods to include industrial pollution

This learning can be used as a foundation to create similar maps in other license areas.

**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.**

The ENA Smarter Networks portal has been checked to confirm that there is no duplication.

**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 application of numerical weather prediction and corrosion rate models to estimate corrosion rates is unique within the context of the UK electricity industry.

### **Relevant Foreground IPR**

not applicable

### **Data Access Details**

not applicable

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

This is a new method 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 acquisition, utilisation, and the overall usefulness of the data and techniques in 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**

As noted in the NIA guidance, certain projects are speculative in nature and yield uncertain commercial returns. This is the case with this

project. There is a commercial risk that the solution trialled in the project is not adopted at the end of the project. This could be because some of the assumptions around the usefulness of the data and the predicted accuracy of the revised ice map might prove incorrect. If the project is successful, it will have proven a technical and novel solution that can be adopted to optimise existing asset design, construction, and maintenance processes, reducing cost to customers.

**This project has been approved by a senior member of staff**

Yes