Scottish & Southern Electricity Networks
TRANSMISSION

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

Sep 2026

Project Reference Number

NIA_SHET_0065

Project Registration

Project Title

Advanced Dynamic Analysis for Power Transition

Project Reference Number

NIA_SHET_0065

Project Licensee(s)

Scottish and Southern Electricity Networks Transmission

Project Start

September 2026

Project Duration

2 years and 4 months

Nominated Project Contact(s)

Brant Wilson – Innovation Portfolio Manager

Project Budget

£698,402.00

Summary

The project addresses the challenge of maintaining effective network modelling and planning as power systems become increasingly dominated by inverter-based renewables, HVDC technologies and complex electronic loads. It provides a coordinated approach to improving study efficiency, model quality and future restoration planning. EMT Modelling investigates whether artificial intelligence, automated tools and international best practice can streamline studies. The Complex and Large Electronic Loads workstream seeks generic models and guidance for technologies such as hydrogen electrolysers, heat pumps and EV charging infrastructure, reducing planning uncertainty. The HVDC Restoration workstream examines international restoration practices and access to a generic grid-forming HVDC converter model. Engagement with EPRI's P39 and P40 programmes provides cost-effective access to research, models, tools and expertise, supporting improved modelling capability amongst other benefits.

Third Party Collaborators

EPRI - The Electric Power Research Institute

Nominated Contact Email Address(es)

transmissioninnovation@sse.com

Problem Being Solved

The consolidated problem is that the network must improve modelling and study capability as the network transitions toward higher volumes of new connections, inverter-based renewables, HVDC assets and large electronic loads.

For EMT Modelling, the number of EMT studies required to assess lightning, switching transients, harmonics, oscillations and protection performance is increasing significantly. Without a step change in efficiency, this demand may require additional internal or

consultancy resource, increasing cost to consumers and still requiring internal review effort.

For Complex and Large Electronic Loads, new load types and novel aggregations of load, including hydrogen electrolysers, heat pumps and electric vehicle chargers, are expected to connect to the network at domestic, commercial, industrial and transmission scales. Proven generic models for these technologies are currently limited, creating uncertainty in EMT and harmonic modelling.

For HVDC restoration, HVDC transmission assets will become increasingly important as new interconnectors connect within Great Britain. While HVDC power transfer is well understood, the use of HVDC grid-forming capability for system restoration is less comprehensively documented in the GB context.

The programme of research focuses on the following areas:

- EMT study volumes are increasing and there is a need to investigate new ways of improving efficiency to reduce associated time and costs.
- Emerging electronic loads require better generic models to reduce assumptions in planning, harmonic and stability studies.
- HVDC grid-forming restoration capability needs to be better understood and modelled before it can inform Local Joint Restoration Plans or future restoration methodology.
- Across all three projects, there is a need to access international research, toolboxes, models and learning without unnecessarily duplicating separate consultancy or research activity.

The projects are complementary: EMT Modelling focuses on study efficiency, Complex and Large Electronic Loads focuses on model quality for new load technologies, and HVDC restoration focuses on grid-forming converter modelling and restoration applications – all aspects looking to address the System Performance of the GB network and what Transmission Owners can do to improve delivery.

Method(s)

Through engagement with EPRI's P39 and P40 research programmes, the project will access relevant research, models, toolboxes and international learning across three linked workstreams. For EMT Modelling, the project will review the application of Artificial Intelligence in automating and processing EMT studies and examine industry tools used internationally to run simplified transformer energisation and switching studies. For Complex and Large Electronic Loads, the project will review heat pump technologies and develop characteristics and generic models for hydrogen electrolysers and electric vehicle supply equipment, drawing on EPRI laboratory testing and OEM engagement. For HVDC restoration, the project will review international applications of HVDC systems in restoration practices and seek access to or development of a generic grid-forming HVDC converter station model, including control architecture, for EMT study and real-time simulation purposes. This approach allows the projects to share programme access, avoid duplication and develop complementary learning for future implementation decisions.

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.

Scope

The scope includes:

- Review of AI applications for EMT study automation and processing
- Review of industry tools for simplified transformer energisation and switching transient studies
- Access to relevant EPRI toolboxes and, where required, temporary or trial EMTP licences
- Review of heat pump system application, operation and electrical characteristics

- Development of generic models for industrial-scale hydrogen electrolyser technology and various scales of electric vehicle supply equipment
- Review of HVDC system restoration practice internationally
- Development or access to a generic model of a grid-forming HVDC converter station suitable for exploratory EMT and real-time simulation studies and production of reports outlining findings, models developed, tool learning and recommendations for further work

Objective(s)

- Review the applicability of Artificial Intelligence to the management, automation and processing of EMT studies.
- Identify hard-coded or industry-standard tools used outside the GB transmission system for simplified EMT study tasks.
- Assess whether transformer energisation and switching transient toolboxes available through EPRI can support Network study processes.
- Review the application, operation and electrical characteristics of heat pump systems in studies.
- Develop or access generic models for industrial-scale hydrogen electrolysers and various scales of electric vehicle supply equipment.
- Review international use of HVDC systems in restoration practice and identify characteristics and limitations relevant to UK Networks.
- Access or develop a generic grid-forming HVDC converter station model, including control architecture, to support EMT and real-time simulation studies.
- Capture findings and learning in reports to inform future implementation, tool adaptation, modelling integration or further innovation work.

Consumer Vulnerability Impact Assessment

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 projects will be deemed successful if they produce clear reports and, where applicable, useful models or tool access that allow SSEN Transmission to decide whether further innovation, adaptation or implementation is justified. Success includes evidence on:

- The applicability of AI and tools to EMT study efficiency
- Delivery or access to generic models for complex and large electronic loads
- Improved understanding of HVDC restoration practice
- Access to or development of a generic grid-forming HVDC converter station model
- Clear recommendations on integration into GB Transmission Operator (TO) study, planning or restoration development processes

Project Partners and External Funding

EPRI, Network Innovation Allowance (NIA)

Potential for New Learning

The projects will generate new learning on the use of Artificial Intelligence and industry-standard tools to improve EMT study efficiency; the modelling of complex and large electronic loads such as hydrogen electrolysers, heat pumps and EV charging equipment; and the application of HVDC grid-forming converters to system restoration in networks with high inverter-based renewable penetration. This learning will clarify whether international research, EPRI toolboxes and generic models can be applied within the operator processes while maintaining technical assurance.

Learning will be shared through project reporting, internal dissemination and wider knowledge-sharing routes where appropriate, including NIA reporting and closedown outputs. This cross-references the dissemination section later in this document.

Scale of Project

The projects are primarily research, modelling, review and assessment exercises rather than field deployments. They will examine AI applications, EMT study tools, generic models for emerging electronic loads, and grid-forming HVDC converter models before any future implementation or operational deployment is proposed. This scale is intended to de-risk future investment by establishing whether the approaches are suitable for Transmission Operators (TOs) and wider GB transmission needs.

Technology Readiness at Start

TRL1 Basic Principles

Technology Readiness at End

TRL2 Invention and Research

Geographical Area

The projects will be undertaken through desktop review, engagement with EPRI research programmes, internal assessment of tools and models, and consideration of applicability to SSEN Transmission and the GB transmission network.

Revenue Allowed for the RIIO Settlement

No allowance has been made for this type of development within the RIIO-T3 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 project expenditure is based on an annual commitment for three years to the relevant EPRI programmes, including access to past research, self-directed research and use of other EPRI catalogue products. This budget is shared across the linked EPRI projects: Enhancing Efficiency and Practices in EMT Modelling, Modelling of Complex and Large Electronic Loads, and HVDC in System Restoration in a Network with High Inverter-Based Renewables Penetration.

Project Eligibility Assessment Part 1

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

The projects have the potential to facilitate the energy system transition by improving the efficiency, quality and confidence of modelling and studies required for new connections, low-carbon technologies, transmission upgrades and system restoration. EMT efficiency improvements may support faster connection and upgrade studies. Generic models for hydrogen electrolysers, heat pumps and electric vehicle supply equipment may reduce uncertainty and improve proactive mitigation of harmonic and stability issues. HVDC restoration learning may support future restoration options, Local Joint Restoration Plans
and Energy System Restoration Standard obligations as the system becomes increasingly inverter-based.

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

N / A – the project is a transmission-focused efficiency and reliability project and does not directly target consumers in vulnerable situations.

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

n/a

Please provide a calculation and/or description of the expected benefits of the solution

The expected benefits are primarily associated with improving study efficiency, reducing modelling uncertainty, improving system security and supporting future restoration options. For EMT Modelling, AI automation and simplified tool-based screening could reduce internal effort and consultancy dependency, lowering study delivery costs and review burden.

For Complex and Large Electronic Loads, more accurate generic models could reduce assumptions in planning studies, help identify harmonic and stability issues earlier, support faster assessment of new connections, and improve confidence in the integration of low-carbon loads.

For HVDC restoration, improved understanding of international restoration practice and access to a grid-forming HVDC converter model could provide a route to future restoration options, faster re-energisation, reduced reliance on fossil-fuel black-start generation and enhanced energy security.

The financial benefit is not yet quantified because benefits depend on whether the research, tools and models are shown to be suitable, accepted into study or planning processes, and capable of supporting future implementation. This crossreferences the success criteria, scale and NIA risk sections, which describe the exploratory nature of the projects.

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

The methods are potentially replicable across GB transmission organisations that undertake EMT studies, model emerging loads, assess harmonic or stability risks, or develop system restoration plans. If the reviewed tools, generic models or HVDC restoration approaches prove useful, the learning could inform wider adoption by other transmission owners and relevant
network licensees.

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

The costs of wider rollout are not yet defined and would depend on tool suitability, licence requirements, model integration, training needs, data access, validation requirements, and any adaptation required for GB study environments, PSCAD/EMTP workflows or system restoration planning processes.

Requirement 3 / 1

Involve Research, Development or Demonstration

Projects 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

Involve Research, Development or Demonstration - Please select all that apply

☐ 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 following learning will be gathered as a result of the project:

- Understanding of AI applicability to EMT study automation and processing
- Assessment of hard-coded tools for simplified transformer energisation and switching transient studies
- Learning on generic modelling of hydrogen electrolysers, heat pumps and electric vehicle supply equipment
- Improved understanding of harmonic, stability and interaction risks associated with emerging electronic loads
- Understanding of HVDC grid-forming converter behaviour and its potential use in system restoration
- Evidence on whether generic models and EPRI toolboxes can support Transmission Operator planning, EMT studies and restoration development
- Learning to inform future implementation, adaptation, procurement, licence decisions or further innovation work

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. Networks must explicitly mention similar projects that they have considered and how these differ.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

The projects are not expected to unnecessarily duplicate existing work because they are focused on applying EPRI research, toolboxes and generic models to SSEN Transmission and GB transmission needs. Each workstream has a distinct focus: EMT study efficiency, complex and large electronic load modelling, and HVDC system restoration.

The projects are linked through the same EPRI P39 and P40 programme activity and budget commitment, but they address different modelling and system planning needs. The Complex and Large Electronic Loads project also extends, rather than duplicates, Grid Supply Point modelling activity because it focuses on unit-level understanding and larger transmission connected loads such as hydrogen electrolysers.

Any related activity will be cross-referenced to avoid duplication and to ensure that learning from linked EPRI, NESO or network innovation work is used efficiently. No duplicate GB network project has been identified from research conducted.

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

The consolidated project package is innovative because it explores the practical application of AI, industry-standard EMT tools, generic electronic load models and HVDC grid-forming converter models to GB transmission study, planning and restoration challenges. It seeks to understand whether international research and EPRI programme outputs can reduce modelling uncertainty, improve study efficiency, support emerging load integration and inform future HVDC-based restoration options.

The key innovative benefits that will be understood upon completion:

- Improved efficiency in EMT study management, setup and processing
- Better prioritisation of high-risk study cases through simplified screening tools
- Reduced reliance on modelling assumptions for hydrogen electrolysers, heat pumps and electric vehicle supply equipment
- Improved ability to identify and mitigate harmonic and stability issues associated with emerging electronic loads
- Improved understanding of grid-forming HVDC converters and their potential role in system restoration
- Evidence to inform future implementation, adaptation or further innovation work across modelling, study efficiency and restoration planning

Relevant Foreground IPR

Any foreground IP created, and any background IP used will remain property of the creating party. IP arrangements are as required of the NIA Governance – with special dispensation being allowed due to the nature of the commerciality of EPRI IP when it comes to dissemination.

Data Access Details

For information on how to request data gathered in the course of this project, see Strategic Innovation Fund (SIF) and Network Innovation Allowance (NIA) Data Sharing Procedure at https://www.ssen-transmission.co.uk/about-us/innovation/.

Additionally, data from this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the Strategic Innovation Fund (SIF) can be found or requested in the ways listed below:

- Via the Smarter Networks Portal at: https://smarter.energynetworks.org. To contact select a project and click ‘Contact Lead Network’. SSEN Transmission already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website at: Innovation - SSEN Transmission (ssen-ransmission.co.uk)
- Via our managed mailbox: transmissioninnovation@sse.com

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

There is a risk that the tools, generic models or HVDC restoration approaches reviewed will not meet the needs of SSEN Transmission or the wider GB transmission industry, and that research and assessment are required before any business-as usual

adoption can be justified.

By undertaking this work through NIA, the TO can de-risk the technology, models and methodology sufficiently to determine whether the tools should be discounted, adapted or progressed toward implementation. Without this de-risking, the network and wider industry may not have sufficient evidence to adopt the solutions, meaning potential consumer benefits from lower costs, improved planning confidence, enhanced reliability and future restoration options could be lost.

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 consolidated EPRI-linked project package. There is a commercial, technical and operational risk that the AI approaches, industry tools, generic electronic load models or HVDC restoration models assessed are not adopted at the end of the projects because they do not provide sufficient improvement, cannot be integrated into existing study or planning processes, or require further adaptation for the GB transmission context. If successful, the projects will provide evidence to support more efficient EMT study delivery, more confident modelling of emerging low-carbon loads, and better-informed consideration of HVDC-based restoration options.

This project has been approved by a senior member of staff

☑ Yes