

NIA Project Registration and PEA Document

Notes on Completion: Please refer to the **NIA Governance Document** to assist in the completion of this form. Please use the default font (Calibri font size 10) in your submission. Please ensure all content is contained within the boundaries of the text areas. The full-completed submission should not exceed 7 pages in total.

Project Registration

Project Title

TOTEM (Transmission Owner Tools for EMT Modelling)

Project Reference

NIA_SHET_0032

Funding Licensee(s)

Scottish Hydro Electric Transmission
SP Transmission
National Grid Electricity Transmission
National Grid Electricity System Operator

Project Start Date

May 2020

Project Duration

11 Months

Nominated Project Contact(s)

Colin Mathieson

Project Budget

£580,000

Contact Email Address

fnp.pmo@sse.com

Lead Sector

Electricity Distribution

☐

Gas Transmission

☐

Electricity Transmission

☒

Gas Distribution

☐

Other Sectors

Electricity Distribution

☐

Gas Transmission

☐

Research Area

ED/ET - Network improvements and system operability	<input checked="" type="checkbox"/>
ED/ET - Transition to low carbon future	<input checked="" type="checkbox"/>
ED/ET - New technologies and commercial evolution	<input checked="" type="checkbox"/>
ED/ET - Customer and stakeholder focus	<input type="checkbox"/>
ED/ET - Safety, health and environment	<input type="checkbox"/>
GD/GT - Future of gas	<input type="checkbox"/>
GD/GT - Safety and emergency	<input type="checkbox"/>
GD/GT - Reliability and maintenance	<input type="checkbox"/>
GD/GT - Repair	<input type="checkbox"/>
GD/GT - Mains replacement	<input type="checkbox"/>
GD/GT - Environment and low carbon	<input type="checkbox"/>
GD/GT - Security	<input type="checkbox"/>

Problem(s)

The GB power system is rapidly evolving as conventional synchronous generation is decommissioned and ever greater levels of renewable sources are connected leading to a much lower level of system inertia and lower short circuit levels. At the same time there are increasing numbers of HVDC links and Flexible AC Transmission systems (FACTS) devices being connected in close proximity in parts of the system. The potential for adverse control interactions between these devices is rising and needs careful consideration within the context of a potentially weaker GB system.

Conventional phasor-based RMS simulation tools have limitations in studying weak, low inertia systems due to the level of detail that is represented. A move to developing more detailed electromagnetic transient (EMT) based models which will address these concerns is proposed as a solution and is seen as a key way of de-risking the integration of the technologies described above.

Method(s)

Manitoba Hydro International (MHI) is a world leader in power system simulation and has developed a way to study electromagnetic transient (EMT) behaviour on large systems, like the full GB transmission system, using the PSCAD simulation software. This project proposes to have MHI develop and validate a full-scale model in PSCAD for the GB transmission system.

Scope

The project scope will be to;

- Develop PSCAD Models of the GB transmission system across the three licence areas;
- Develop new tools for automatic reduction of the PSCAD model to produce both static and dynamic equivalents of the reduced areas;
- Develop new tools for configuration and quick initialisation of the EMT models to support future work by the Transmission Owners (TOs);
- Determine the detailed requirements and establish shared computing resources that provide the TOs with a facility that can be used to conduct the most detailed and computationally intensive studies of the full GB system;
- Perform illustrative studies based on the developed PSCAD network including;
 - sub-synchronous resonance investigations
 - control instability studies
 - switching studies on a selection of substations
- Participate in a knowledge transfer workshop to provide the TOs with the capability to use the models, extend them as required in the future, and perform a range of studies.

Objective(s)

The objectives of the project are as follows:

1. Build and validate a PSCAD model of the GB transmission network and from that derive separate models for each of the three TO licence areas;
2. Deliver tools for PSCAD model manipulation and analysis that will support the TOs in their use of the GB model;
3. Provide the GB TOs with the knowledge and understanding required to adopt the models and put them into use; and
4. Establish shared computing resources for running the most complex models.

Success Criteria

The project will be successful if a working PSCAD model can be created and used to perform illustrative studies.

Technology Readiness Level at Start

5

Technology Readiness Level at Completion

7

Project Partners and External Funding

Scottish Hydro Electric Transmission will contribute £185k
SP Transmission will contribute £180K
National Grid Electricity Transmission will contribute £180k
National Grid Electricity System Operator will contribute £35k

Potential for New Learning

This project will provide new tools and resources to model the transmission system which goes beyond current established models:

- enabling much larger sections of the network to be investigated in the EMT domain;
- the ability to perform critical studies on weak grids;
- enhance the support and level of service that the TOs can provide to Users seeking new connections;
- investigation into transient disturbances; and
- will provide the ability to incorporate sensitive vendor models into the network and study the effect, thus enabling development of mitigation plans where necessary.

Scale of Project

The development of the PSCAD model of the whole UK system is applicable to all three Transmission Owners, hence the presentation of a joint project proposal.

Geographical Area

GB

Revenue Allowed for in the RIIO Settlement

No allowance has been made for developing a GB EMT model.

Indicative Total NIA Project Expenditure

The total expenditure for the project is £ 580k.
90% (£522k) is allowable NIA expenditure.

Project Eligibility Assessment

Specific Requirements 1

1a. A 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 systems and software)	<input checked="" type="checkbox"/>
A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)	<input type="checkbox"/>
A specific novel operational practice directly related to the operation of the Network Licensees System	<input type="checkbox"/>
A specific novel commercial arrangement	<input checked="" type="checkbox"/>

Specific Requirements 2

2a. Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees



Please answer one of the following:

i) Please explain how the learning that will be generated could be used by relevant Network Licenses.

This is a joint project and will enhance learning, knowledge and ability for all three transmission owners

ii) Please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the Project.

TOTEM addresses the Network Reliability/Availability and Efficiency challenge as it will improve the modelling ability of the network and enable voltage quality issues to be studied in much greater detail.

Is the default IPR position being applied?

Yes

☐

No

☒

If no, please answer i, ii, iii before continuing:

i) Demonstrate how the learning from the Project can be successfully disseminated to Network Licensees and other interested parties

Learning will be shared from the project in the normal manner, reports and dissemination events.

ii) Describe how any potential constraints or costs caused, or resulting from, the imposed IPR arrangements

The associated Network Licensees will adhere to industry codes in accordance with their license conditions.

This will facilitate the models built under this project to be shared with other interested parties in accordance with the present protocols.

iii) Justify why the proposed IPR arrangements provide value for money for customers

The associated Network Licensees will adhere to industry codes in accordance with their license conditions.

This will facilitate the models built under this project to be shared with other interested parties in accordance with the present protocols.

2b. Has the Potential to Deliver Net Financial Benefits to Customers

☐

Please provide an estimate of the saving if the Problem is solved.

n/a

Please provide a calculation of the expected financial benefits of a Development or Demonstration Project (not required for Research Projects). (Base Cost – Method Cost, Against Agreed Baseline).

n/a

Please provide an estimate of how replicable the Method is across GB in terms of the number of sites, the sort of site the Method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

The models will cover the whole GB Transmission system.

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

n/a

2c. Does Not Lead to Unnecessary Duplication



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

Working together to develop and validate a GB solution will enable all three Transmission Owners to optimise on the knowledge and learning, removing duplication.

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

National Grid ESO is pursuing an innovation project that aims to extend existing models they have developed in PSCAD covering limited parts of the GB transmission system. The emphasis of the NGESO project is on the development of new component models, e.g. how to represent a specific HVDC link. The NGESO project does not include the development of new tools and methods, which will be important in supporting future full GB EMT models. The two projects are therefore complementary.

National Grid Electricity Transmission has a parallel project that focuses on the tools and methods for translation of models from the DigSILENT PowerFactory format, as currently used for most power systems analysis at NGET, to the PSCAD format. The NGET project complements this joint TOTEM project by focusing on a specific aspect of model manipulation that will be useful as the full GB model is adopted in business as usual.

Additional Governance Requirements

Please identify that the project is innovative (i.e. not business as usual) and has an unproven business case where the risk warrants a limited Research, Development or Demonstration Project to demonstrate its effectiveness



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

Simulation tools with much greater processing power are only now starting to become available, which has enabled the development of an Electromagnetic Transients Models (EMT) to represent the full GB Transmission network. The project will also develop innovative tools for network reduction and equivalencing.

ii) Please identify why the Network Licensee will not fund such a Project as part of its business as usual activities

This new way of modelling the Transmission system, coupled with the different way of interoperating how the electrical system will flex, is in the development stages and still requires validation and testing. There are business risks associated with implementing a solution making it unlikely to secure general funding.

iii) 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

Developing the solution under NIA will enable knowledge sharing between the Transmission Owners and ensure that together this new modelling package is developed and validated for the GB system.

Please confirm this project has been approved by a senior member of staff

