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NIA Project Registration and PEA Document

Date of Submission

May 2020

Project Reference Number

NIA_SHET_0032

Project Registration

Project Title

TOTEM (Transmission Owner Tools for EMT Modelling)

Project Reference Number

NIA_SHET_0032

Project Licensee(s)

Scottish and Southern Electricity Networks Transmission

Project Start

May 2020

Project Duration

1 year and 11 months

Nominated Project Contact(s)

SSEN - Colin Mathieson

Project Budget

£580,000.00

Summary

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.

Nominated Contact Email Address(es)

transmissioninnovation@sse.com

Problem Being Solved

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:

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;

Deliver tools for PSCAD model manipulation and analysis that will support the TOs in their use of the GB model;

Provide the GB TOs with the knowledge and understanding required to adopt the models and put them into use; and

Establish shared computing resources for running the most complex models.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

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

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.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

GB

Revenue Allowed for 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 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)

N/A

Please provide a calculation of the expected benefits the Solution

N/A

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

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

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

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

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

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.

- 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.

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.

n/a

Additional Governance And Document Upload

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.

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

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.

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.

This project has been approved by a senior member of staff

Yes