

NIA Project Close Down Report Document

Date of Submission

Jul 2022

Project Reference Number

NIA_SHET_0032

Project Progress

Project Title

TOTEM (Transmission Owner Tools for EMT Modelling)

Project Reference Number

NIA_SHET_0032

Funding Licensee(s)

NG ESO - National Grid ESO

Project Start Date

May 2020

Project Duration

1 year and 11 months

Nominated Project Contact(s)

SSEN – Tim Sammon, Innovation Programme Delivery Manager

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.

Objectives

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.

Success Criteria

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

Performance Compared to the Original Project Aims, Objectives and Success Criteria

Project Background

Conventional phasor-based Root Mean Square (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 the focus of this project. If successful it will de-risk the integration of various renewable generation resources and power electronics devices to the GB transmission network.

Project progress

Build and validate a Power Systems Computer Aided Design (PSCAD) model of the GB transmission network and from that derive separate models for each of the three TO licence areas.

Manitoba Hydro International (MHI) were awarded the Project and have undertaken the initial building of the model. At Project closure MHI had completed the individual system models for the two Scottish Transmission Owners.

There was significantly more design and development work required than initially anticipated for the Transmission system model of England and Wales. Unfortunately, it was not possible for MHI to complete the National Grid Electricity Transmission (NGET) system model.

Therefore, it has not been possible to assemble the whole GB transmission network PSCAD model and validate it.

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

Over the course of the Project, the associated tools and their functionality for PSCAD model manipulation have been discussed and decided upon. Delivery will occur within the TOTEM Extension Project.

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

MHI have provided an initial insight into the PSCAD models. Further training and support sessions will be held to help the GB TOs and National Grid Electricity System Operator (NGESO) increase their knowledge and ability to run the new PSCAD models.

Establish shared computing resources for running the most complex models

MHI, on receiving the GB transmission network owners base RMS system models, were able to present different computer, compiler, and licensing options. The Scottish TOs agreed on a combined solution package, which will be located at the National HVDC Centre in Cumbernauld, Scotland, where both Scottish TOs can have access to the PSCAD models.

To date NGET have selected and secured their preferred computing resource. NGESO have decided to procure their own computing resource, which will be funded as part of the TOTEM Extension Project.

Required Modifications to the Planned Approach During the Course of the Project

The first modification requested was for the inclusion of National Grid Electricity System Operator (NGESO), along with a NGESO NIA spend allocation of £35k.

A second modification was made at the end of March 2021, to request an extension to the project duration. The request was made in relation to the length of time it took to develop the 4-Party Agreement which incorporates all Parties individual contractual requirements suitably. The necessary legal resource support was impacted by other more urgent contractual work amendments associated with Covid-19.

Lessons Learnt for Future Projects

The learning captured during this project is outlined below:

- Developing the 4-Party Agreement, which required finding common ground between the individual GB TOs, has emphasised the different contracting approaches that each of the GB TOs use. The deliverables associated with this Project are highly technical and require the procurement of specific computing equipment to sit internally within each of the GB TO Parties premises. Given the

surrounding complexity of the Project it was not suitable for placement with an external third-Party to project manage. Using a third-Party to co-ordinate would have enabled a simpler interface contractually i.e. each of the GB TOs would have contracted separately with the third-Party project management organisation, then the third-Party would have contracted the PSCAD model supplier.

- This was the first time MHI had undertaken a whole scale network PSCAD build with a combination of different TOs. The task turned out to be more complex than originally anticipated, leading to the extension of project timescales. It is important to enter a modelling contract providing as much clarity as possible in the early stages to enable a realistic timescale. If possible, initial sharing of the network data (e.g. Electricity Ten Year Statement (ETYS) network model) with potential suppliers at precontract stage is suggested to ensure proper understanding of the project scope. Once under contract any additional information needs to be provided as soon as possible, to enable the contractor to provide a realistic timescale and, where possible, share how it could be accelerated.

- Covid has had unexpected impacts such as the computer chip shortage. The last 2 years has highlighted the importance of the unforeseen circumstances Clauses in any contract and the inability to cover all possible eventualities. To turn the event into a positive it has been a test of resilience and continual open dialogue to maintain the course of the project across multiple parties.

- The PSCAD software is more complex than other tools currently used for power system analysis and requires greater flexibility and control over the computing environment it runs in. For example, it is necessary to be able to install and link to different fortran compilers according to the specific models being used. This presents challenges for the IT infrastructure and support in the TOs that may have to develop new approaches to support the use of this type of software. In establishing a high-power computing resource, the project is exploring and confirming the requirements that can be applied in future projects.

Note: The following sections are only required for those projects which have been completed since 1st April 2013, or since the previous Project Progress information was reported.

The Outcomes of the Project

The project has positively developed;

- A multi-Party Agreement which enables the GB Transmission Owners to work together to acquire and validate a new system model that will enhance, as well as de-risk the integration of new technologies.
- MHI have completed the build of the PSCAD models for both Scottish TOs.
- Computing resource for GB TOs has been selected and procured.

Data Access

See Network Innovation Competition (NIC) and Network Innovation Allowance (NIA) Data Sharing Procedure at <https://ssen-innovation.co.uk/innovation-strategy/>

Foreground IPR

Please note that the new models that will be developed via this Project will be shared under the present mechanisms that the Transmission Owners must adhere to.

Planned Implementation

To complete this Project, the TOTEM Extension Project has been raised under RII0-T2 funding.

Other Comments

The TOTEM project has been discussed in larger European forums, as there is a high level of interest in PSCAD system modelling developments.

Standards Documents

No operational type documents have been produced as yet, it is anticipated that they will follow as part of the TOTEM Extension Project.