Public

Grid Code Development Forum

7 May 2025

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Public

Agenda

1	Introduction, meeting objectives and review of previous actions - **Claire Newton, NESO**	
2	Code Administrator Update – **Lizzie Timmins, NESO (Code Administrator)**	
3	Modelling Requirements for Co-located Sites Update – **Tanmay Kadam, NESO**	
4	EMT Modelling GC0141 and GC0168 - **Steve Sommerville, AURORA POWER CONSULTING**	
5	EMT Model Development - **Jay Ramachandran, NESO**	
6	AOB and Meeting Close - **Claire Newton, NESO**	

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GCDF – Objectives and Expectations

Objective
Develop ideas, understand impacts to industry and modification content discussion, in relation to Grid Code related issues.
Anyone can bring an agenda item (not just NESO!)

Expectations
Explain acronyms and context of the update or change
Be respectful of each other's opinions and polite when providing feedback and asking questions
Contribute to the discussion
Language and Conduct to be consistent with the values of equality and diversity
Keep to agreed scope

The Forum will be recorded and made available on the GCDF webpage along with summary notes.

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Code Administrator Update

Key Updates since last GCDF

New Modifications / Nominations

- **GC0179** 'Removal of Balancing Code No.4 from the Grid Code' – nominations will open on 06 May and **close on 28 May**
- **GC0180** 'Corrections to the Grid Code following implementation of GC0175'

Decisions

None

Implementations

- **GC0172** 'Replacing References to Electricity Supply Industry Arbitration Association' - implemented on 03 April
- **GC0159** 'Introducing Competitively Appointed Transmission Owners' - implemented on 08 April

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Key Consultations in March

Workgroup Consultations

- **GC0103** 'The introduction of harmonised Applicable Electrical Standards in GB to ensure compliance with the EU Connection Codes' - Workgroup Consultation will open on 14 May and **closes on 06 June**

Code Administrator Consultations

- **GC0166** 'Introducing new Balancing Mechanism Parameters for Limited Duration Assets' - Code Administrator Consultation will open on 06 May and **closes on 09 June**

Appeals Window

- **GC0180** 'Corrections to the Grid Code following implementation of GC0175' - Appeals Window will open on 06 May and **closes on 28 May**

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Prioritisation Stack (as agreed at Panel on 01 May 2025)

Mod Number	Previous Priority No:	Priority No	Title
GC0139	1	1	Enhanced Planning Data Exchange to Facilitate Whole System Planning
GC0155	2	2	Clarification of Fault Ride Through Technical Requirements
GC0166	3	3 (before CAC)	Introducing new Balancing Programme Parameters for Limited Duration Assets
GC0176	4	3	Introduction of Demand Control Rotation Protocol within Operating Code 6 of the Grid Code
GC0178	5	4	Temporary Overvoltage - Specification of Limits and Clarification of Obligations
GC0168	6	5	Submission of Electro Magnetic Transient (EMT) Models
GC0174	7	6	Removal of obligation to provide EU Transparency Availability Data as specified in OC2.4.7
GC0169	8	7	Material changes identified from Grid Code Modification GC0136 and Consistency of requirements between the Connection Conditions and European Connection Conditions
GC0173	8	7	Consistency of Technical and Compliance Requirements between GB and European Users
GC0164	9	8	Simplification of Operating Code No.2
GC0103	10	9	The introduction of harmonised Applicable Electrical Standards in GB to ensure compliance with the EU Connection Codes
GC0179	N/A	10	Removal of Balancing Code No.4 from the Grid Code
GC0140	11	11	Grid Code Sandbox: enabling derogation from certain obligations to support small-scale trials of innovative propositions

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Grid Code Elections Update – Generator Seat 2025

Due to the resignation of one of the Generator Panel members appointed through the Grid Code Review Panel Election 2024, we are opening nominations for this electable seat.

For the avoidance of doubt, this election does not apply to any other seats on the Grid Code Review Panel.

Only Generator parties that were CUSC Schedule 1 Users or Materially Affected Parties (as designated by Ofgem) on 31 August 2024, who do not currently have a Generator Panel Member on the Grid Code Review Panel (see page 3 for a list of Panel members and note that Alternate members are eligible for election), are entitled to nominate one candidate to stand for election by completing and returning the nomination form to us.

Grid Code Elections Update – Generator Seat 2025

Date	Milestone
01 May 2025	<u>Invitations sent out to CUSC Schedule 1 Users / Materially Affected Parties to nominate candidates to stand for election.</u>
23 May 2025	Nomination forms to be returned no later than 5pm.
02 June 2025	List of candidates and voting papers to be circulated, or we will announce the outcome of the Elections.
16 June 2025	Voting papers to be returned no later than 5:00pm.
26 June 2025	Election results will be announced.
27 June 2025 – 31 December 2026	Newly elected Panel member will take up office.

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Useful Links

Ofgem's expected decision dates/ date they intend to publish an impact assessment or consultation, for code modifications that are with them for decision are available here

Updates on all Modifications are available on the Modification Tracker here

The latest Grid Code Review Panel Headline Report and prioritisation stack are available here

If you would like to receive updates from the Code Administrator on Grid Code modifications, please join the distribution list here

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Modelling Requirements for Co-located Sites - Update

Modelling Requirements for Co-located Sites

**Examples of Co-located Sites of Interest:**

1. A GB Code User intending to install additional Power Generating Modules of new technology behind the existing Grid Entry Point
2. An EU Code User (pre-1st Sept. 2022) intending to install additional Power Generating Modules of new technology behind the existing Grid Entry Point

Grid Code Modelling Requirement:

- PC.A.5.4.2 (g) (i): For any **Power Park Unit**s in a **Power Park Module** with a **Completion Date** after 1 September 2022 and any **Power Park Units** and/or **Power Park Module(s)** subject to a <u>control system change and/or a **Modification** to any **Plant** or **Apparatus**</u> after 1 September 2022, control system models in accordance with PC.A.9 should be supplied covering the full information required under PC.A.5.4.2 (a), (b), (c), (d), (e) and (f).

Modification:

- Any actual or proposed replacement, renovation, modification, alteration or construction by or on behalf of a **User** or **The Company** to either that **User's Plant** or **Apparatus** or **Transmission Plant** or **Apparatus**, as the case may be, or the manner of its operation which has or may have a **Material Effect** on **The Company** or a **User**, as the case may be, at a particular **Connection Site.**
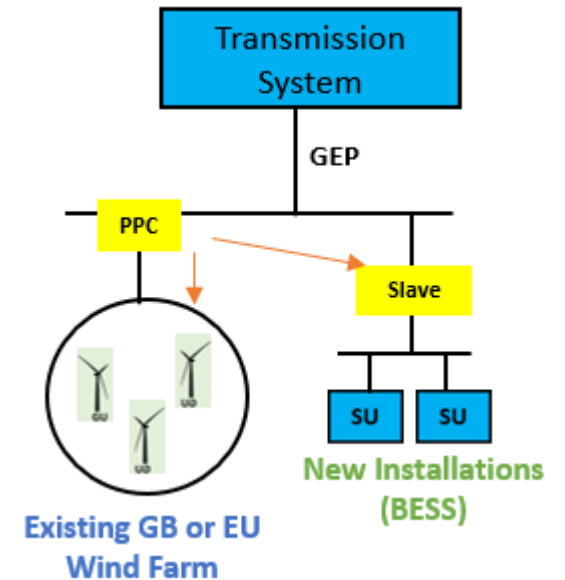
The existing PPC would be modified to also use the reactive power capability available from new installations
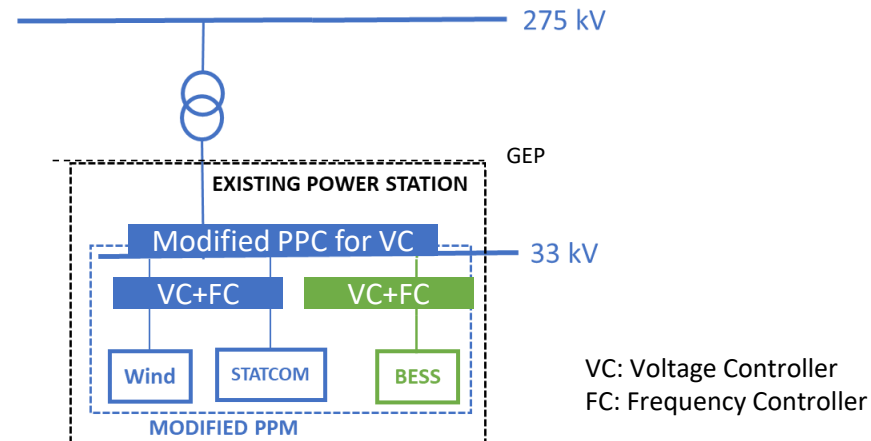
Modelling Requirements for Co-located Sites

- The term 'Control System Change' constitutes any changes to the control function block diagrams and/or system architecture, including input and output signals. This also includes changes to the generator control (control system associated with Main Plant and Apparatus), reactive power compensation equipment control and the power park controllers (PPC)

- A parameter change (gain or time constant) may not invoke any new modelling requirements in line with PC.A.9; however, any such change(s) shall be discussed and agreed with The Company

- **Where it is the intention of the existing User to co-locate different technologies, this would constitute a modification or control system change of the existing PPM and would invoke the modelling requirements of PC.A.9 in accordance with PC.A.5.4.2**
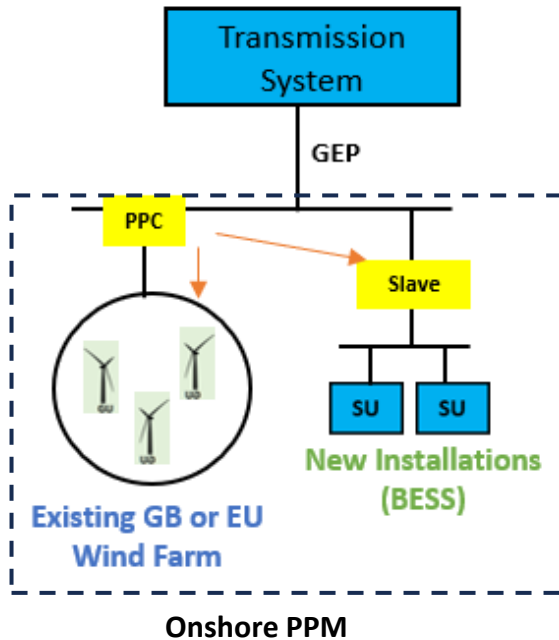
Example:
User decides to add new BESS behind an existing Grid Entry Point, such that the existing PPC controls the voltage performance of both the existing and new generators. Since the PPC would be modified in this case, the PPM shall be caught by the modelling requirements of PC.A.9

Onshore PPM

VC: Voltage Controller
FC: Frequency Controller

Modelling Requirements for Co-located Sites

PPM Definition:

Grid Code Definition:

- A collection of **Non-Synchronous Generating Units** that are powered by an **Intermittent Power Source** or connected through power electronic conversion technology or **Non-Synchronous Electricity Storage Units**, joined together by a **System** (registered as a **Power Park Module** under the PC) <u>with a single electrical point of connection directly to the **Onshore Transmission System**</u> (or **User System** if **Embedded**) with no intermediate **Offshore Transmission System** connections

- Based on the previous feedback received in the GCDF on 04/12/2024, we have considered the issues raised particularly aligning the Power Park Module definition with European Codes and concluded that we wish to retain the current definitions of Type A, B, C and D Power Generating Modules which includes Power Park Modules

- Where a Power Park Module contains mixed technologies (eg. PV and BESS or Wind and BESS), each technology shall be registered as a separate BM Unit. Both the technologies would be considered to be part of the same Power Park Module unless each technology has a separate connection point to the Total System

- To summarise, when an existing User intends to co-locate different technologies behind an existing connection point, this would be classified as modification to an existing Power Park Module that will invoke modelling requirements as per PC.A.9

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Grid Code Development Forum

EMT Modelling
GC0141 and GC0168

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GC 0141

New Generation Projects

- The EMT modelling process is generally ok – just some issues and headaches

- The Guidance Note is not 100% clear on what simulations are actually needed. Is it a repeat of ECP.A.3? Guidance note section 9.1 & Appendix C don't align.

- Wording / intent on protection is not clear. It is ok for Inverter Based Generation – but potentially complex and difficult for thermal generation with discrete relays.

- Guidance for EMT Models (July 2023) is out of step.

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GC 0141

New Generation Projects

- Simulation time step of 10 μs with longer simulation times for LFSM and FSM studies is a pain. NESO have indicated informally they would be happy to relax this, but many vendor models need the small time step. Suggest that the simulation duration of these studies is reconsidered and a BC3 type fast ramp / de-ramp used instead.

- IEEE 9-Bus method is a bit vague and has problems, as the fault level is very low. Suggest a generic synthetic equivalent network is developed by NESO to be used instead.

- Other than a couple of lines in Planning Code section – no specific requirement for studies in Grid Code main text.

GC 0168

Existing Generation - General

- Historical Data is not always fully available or accurate.

- OEM support is limited.

- EMT models have been asked for plants facing minor upgrades – putting plants off updating systems due to the concern of the process.

- Grid Code requirements have changed – it is not reasonable to expect historical plants to comply with modern Grid Code.

- NESO have indicated some flexibility here – but it needs defining early. EMT modelling is expensive & difficult.

GC 0168

Existing Generation – Thermal Plants

- Thermal plants are a challenge – accurate Governor and AVR modelling is difficult.

- What accuracy level are NESO looking for?
  - PSCAD library is basic i.e. no Gas Turbine Governor, SCL, OEL or UEL models
  - Standard governor models available are also simplistic – real systems are more complex
  - Standard AVR models are also somewhat simplistic – IEEE 421.5 acknowledges this
  - PSCAD standard models of AVRS / Governors are locked – cannot be adjusted easily.
  - Problems adding

- Similar issue to GC0141 on modelling of discrete protection relays

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GC 0168

## Existing Generation – Inverter Based Plant

- OEMs may not have historical models / versions that correlate with the version of equipment installed i.e. they may have a PSCAD model of a newer WTG, but not for older historical plant.

- Firmware updates to control systems can be out of step.

- Some older OEMs may be out of business?

EMT Model Development

Jay Ramachandran

NESO
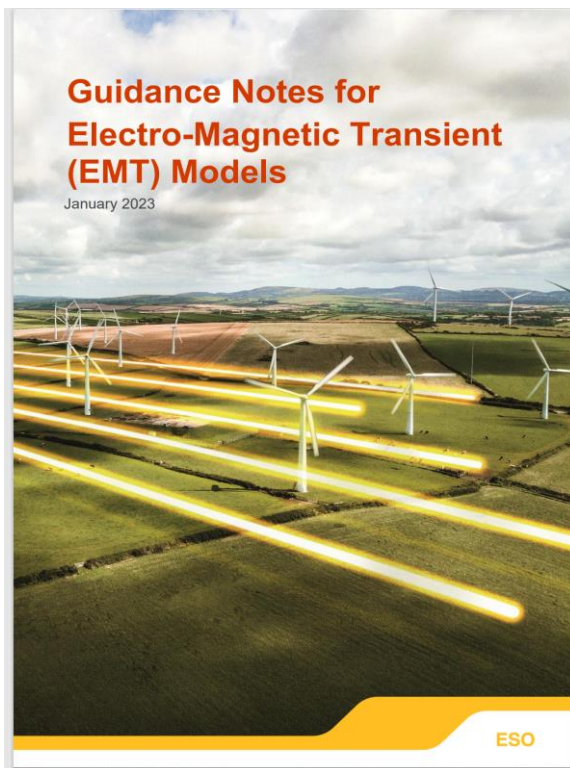National Energy
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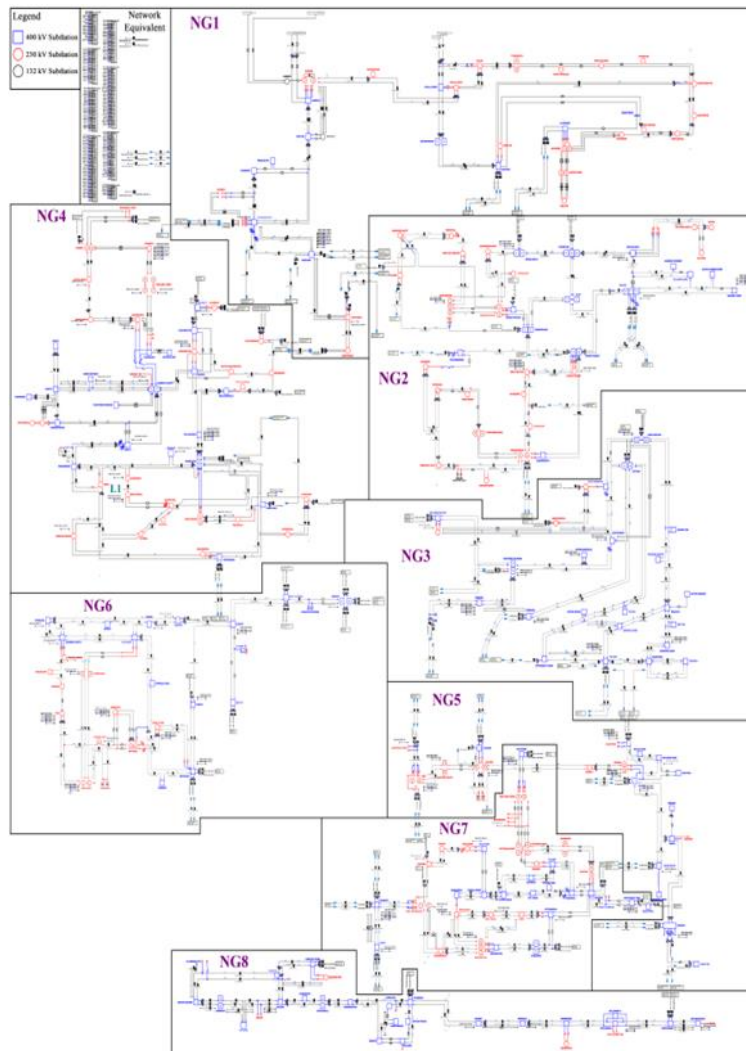
GB wide EMT Model

- Through Network Innovation Allowance (NIA) project entitled Transmission Owner Tool for EMT Modelling (TOTEM), led by SSEN in partnership with NGET, SPEN and NESO, GB-wide EMT model has been developed.

  - User's models are included only if available to the NESO.

- TOTEM model is assumed as a base model for wider network analysis.

- For the validation of models, not the entire GB-wide EMT model is used. Only a particular region/ area would be selected, depending upon the connection site.

- Validation of Users models with WN model requires High Performance Computers (HPC) and enhanced licences as well. NESO migrated to Cloud platform to run wider EMT network analysis.

- Once the User model has been validated then it will be integrated with the base model.

Model Submission Requirements

- Unless otherwise specified in the Bilateral Agreement, the timescale for fulfilling the model submission requirements is 3 months prior to the issue of the Interim Operational Notification (ION) and 1 month prior to the issue of a Limited Operational Notification (LON).

  - ➢ All directly connected sites are required to provide RMS and EMT models (the NESO started to receive EMT models from Users connecting since September 2022) following the implementation of GC0141.

  - ➢ RMS models are required to be open-source and not contain DLL's, EMT models may be encrypted.

- Grid Code specifies that models submitted by Users to the ESO can be shared with relevant Transmission Owners (TOs).

- Grid Code specifies that Users should sign the agreement on sharing the EMT model with other Users. If it is not agreeable, Users should provide equivalent EMT model that is representative of the plant and apparatus behaviours, that can be sharable with other Users.

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EMT Model Requirements

Guidance Notes for Electro-Magnetic Transient (EMT) Models

January 2023

ESO

download (nationalgrideso.com)

Efficiency	Usability	Fidelity	Documents	Maintenance

EMT Model Guidance

PSCAD Version 5	Intel Fortran Compiler V19.2 or higher	Visual Studio 2019 and newer	Encrypted model

32 Bit Compiler

Initialisation within 4 to 6 seconds
(Currently 3 seconds)

Both 32- and 64- Bit Compiler models (for future)

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EMT Model Requirements

- Recently, the NESO also provided guidance on system oscillation assessment of IBRs that describe to Users on how to demonstrate the appropriate damping performance of IBRs against potential system oscillations.

- NESO also reviews / verifies the frequency scan reports provided by the Users, to check on any potential system oscillations.

https://www.neso.energy/document/301686/download
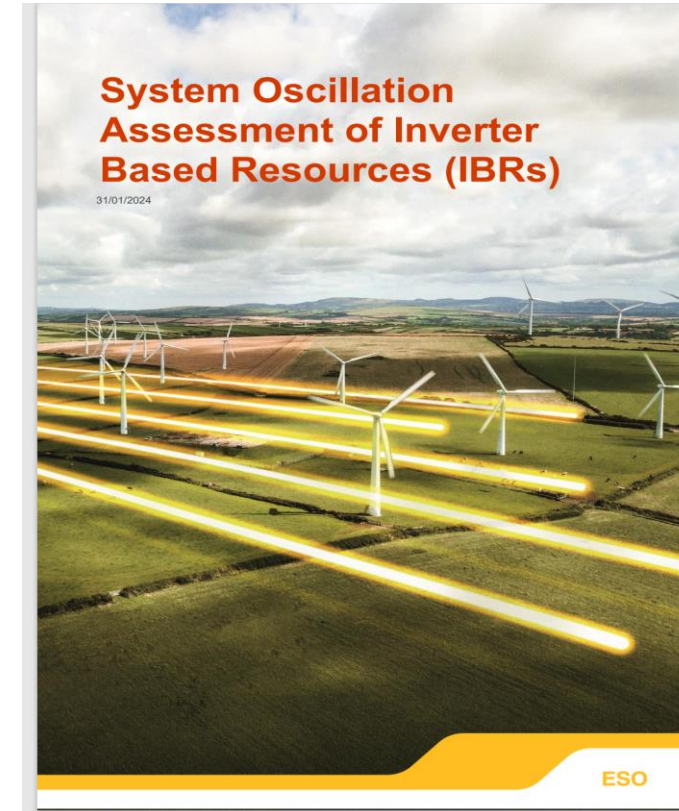
Code Modification

GC0168

- Existing Users to provide the EMT models to enable analyses such as system oscillations, inverter stability and Transient Over Voltage.

- Proposed to develop a GB wide Electrical Standard which will provide guidance on a step-by-step approach on collecting EMT models from Users connected before September 2022 and EMT modelling guidelines.

- https://www.neso.energy/industry-information/codes/gc/modifications/gc0168-submission-electro-magnetic-transient-emt-models

CM097

- To mandate the collection of the EMT and RMS models from TOs and provide for a possibility to share these TO models with relevant Users, as well as permit the NESO to share Users' EMT and RMS models to TOs to carry out studies.

- It will help to enable safe and reliable operation of the system and enhance the security of GB electricity supply.

- https://www.neso.energy/industry-information/codes/stc/modifications/cm097electromagnetic-transient-emt-and-root-mean-square-rms-model-submission-transmission-owners-tos

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Possible Approaches

In general, Users/developers should explore multiple pathways for modelling legacy plants, depending on the level of detailed information available to them, including but not limited to:

(a) **Vendor-specific model** for the site-specific equipment, with site-specific parameters provided by vendor.

(b) **User-defined site-specific models**, with parameters derived from plant design information and historical operational measurements available to the proponent.

(c) **Vendor-specific model with similar technology** from the same OEM, with parameters derived from plant design information and historical operational measurements available to the proponent.

(d) **Generic model**, with parameters derived from plant design information and historical operational measurements available to the proponent.

- From a technical modelling perspective, industry experience suggests that material interactions between legacy and new plant in the system are most likely to arise from one of the following four components:

  - Outer control loops for voltage and/or reactive power within a plant.

  - Inner control loops driving unit-level voltage and current, including fault ride-through modes and PLL dynamics for electronic equipment.

  - Outer control loops for dispatch and regulation of active power production or consumption by the plant.

  - Outer control loops for frequency responses and control.

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Key Projects on EMT Modelling

Developing Enhanced Techniques to Evaluate Converter-dominated Transmission System Operability (DETECTS) - Provided a GB South Coast stability analysis based on detailed EMT analysis.

Data-driven Network Dynamic Representation for Derisking the HVDC and Offshore Wind - Using PSCAD and data driven techniques to obtain equivalent dynamic models for EMT analysis, and decrease the reliance on detailed vendor models

Delivering a platform to run both RMS and EMT simulations simultaneously. Project led by NGET. ESO also analysing the co-simulation possibilities within Power Factory (RMS – EMT).

To create a surrogate EMT model that has sufficient accuracy as Black Box EMT model by using Machine learning techniques.

DETECTS   TOTEM   D3   SSO Identification   Co-Simulation   Wider EMT GB Model   Neural BB   Grid Connection Simulation Tool

Transmission Owner Tools for EMT Modelling (TOTEM) - Project led by SSEN. Delivering a validated full scale GB model to conduct wider EMT analysis

Utilising the TOTEM model to develop a python-based tool that can identify Sub Synchronous Oscillations, by scanning a high number of scenarios and automating the end-to-end process

Speeding up the process of performing EMT simulations and increasing the flexibility of performing transient studies to make it practical to use for system operation processes

To develop cloud environment where WAN will be located for Users to connect their model and carry out analysis, without viewing the details of WAN.

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Thanks

How to download GCDF Meeting Invites

Step 1:Go to the GCDF website here - [Grid Code Development Forum (GCDF)](#)

Step 2: Click the link 'Join us for GCDF meetings' here -

Join us for GCDF meetings

If you would like to join us for GCDF meetings in 2025 you can download the meeting invites and joining instructions.

Step 3: Download the meetings into your calendar

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NESO Compliance seminar material

Available at:

[Customer Connection events | National Energy System Operator](#)

In in Customer Connection Events / 2025 Past Events / 25 February Compliance Seminar.

AOB