Public

Code Administrator Consultation

GC0168:

Submission of Electromagnetic Transient (EMT) Models

Overview: This modification seeks to require certain Users to provide National Energy System Operator (NESO) with EMT models to enable the analysis of issues such as system oscillations, inverter instability and transient overvoltage (ToV).

Modification process & timetable

1. **Proposal Form**
   05 March 2024
2. **Workgroup Consultation**
   23 January 2025 - 21 February 2025
3. **Workgroup Report**
   15 April 2026
4. **Code Administrator Consultation**
   05 May 2026 - 08 June 2026
5. **Draft Modification Report**
   17 June 2026
6. **Final Modification Report**
   16 July 2026
7. **Implementation**
   10 Business Days after decision

Have 5 minutes? Read our Executive summary
Have 60 minutes? Read the full Workgroup Report
Have 120 minutes? Read the full Workgroup Report and Annexes.

Status summary: The Workgroup have finalised the proposer's solution as well as one alternative solution.

This modification is expected to have a: High impact on Generators (including both GB Generators and EU Generators), National Energy System Operator, Network Operators, Interconnector Owners, Transmission Owners and Non-Embedded Customers.

Modification drivers: Efficiency, GB Compliance, Harmonisation, New Technologies, System Operability, System Planning, System Security, Transparency

Governance route	Standard Governance modification with assessment by a Workgroup	
Who can I talk to about the change?	**Proposer:** Frank Kasibante (NESO) frank.kasibante1@neso.energy	**Code Administrator Chair:** Kat Higby (NESO) Katharine.Higby@neso.energy
How do I respond?	Send your response proforma to grid.code@neso.energy by **5pm** on **08 June 2026**	

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Executive Summary

This modification seeks to require certain Users to provide National Energy System Operator (NESO) with Electromagnetic Transient (EMT) models to enable analysis of issues such as system oscillations, inverter instability and transient overvoltage (ToV) on the Transmission System.

What is the issue?

Great Britain's power system is moving towards net zero carbon operation.

Connections to the National Electricity Transmission System (NETS) are transitioning from large synchronous generation to a large number of smaller Electronic Power Converters (EPCs). This is causing new and varying challenges to the power system, especially in view of the different operating and performance characteristics of EPCs whose power electronics interact with the NETS in a different way to the older Generators. Examples of these challenges include control interactions, low fault level, inverter instability and ToV.

NESO requires EMT models from certain Users in order to analyse and understand how these interactions affect the NETS under different system conditions**.**

What is the solution and when will it come into effect?

Proposer's solution: The proposed solution is to require the provision of EMT models from Users with certain legacy assets with a completion date before 01 September 2022, upon request from The Company. A new Electrical Standard which will indicate model requirements and the approach for retrospective submission will also be introduced (available in **Annex 08**).
Implementation Date: 10 Business Days following an Authority decision.

Alternative Request 1: The proposed alternative WAGCM1 Introduces a deferred effective date for GB Code Users, allowing immediate effect of GC0168 for EU Code Users but delaying applicability to GB Code Users until cost recovery is in place within the CUSC.

The alternative was voted in by the Workgroup and became Workgroup Alternative Grid Code Modification 1 (WAGCM1).

Implementation Date: 10 Business Days following an Authority decision.

What is the impact if this change is made?

The modification will positively impact system security and reliability by requiring EMT models, enabling NESO to analyse oscillations, inverter instability, and ToV risks more accurately. It also supports efficient system planning and helps avoid unnecessary investment or operational costs by improving the accuracy of pre and post-fault studies.

Workgroup conclusions: The Workgroup concluded by majority that WAGCM1 better facilitated the Applicable Objectives than the Baseline. The Workgroup did not agree by majority that the original solution better facilitated the Applicable Objectives than the Baseline.

Interactions

CUSC modifications CMP456: Cost recovery for legacy plant in relation to GC0168 and CMP466: CMP456 Consequential Charging Modification have been raised relating to the introduction of a cost recovery mechanism.

Corresponding STC modification CM097 – Electromagnetic Transient (EMT) and Root Mean Square (RMS) Model Submission for Transmission Owners (TOs).

A separate modification PM0147 was established to introduce a new System Operator-Transmission Owner Code Procedure (STCP) 12-2.

Grid Code Modification GC0139: Enhanced Planning-Data Exchange to Facilitate Whole System Planning – due to the interaction with GC0139, which could be implemented ahead of GC0168, the Workgroup proposed two sets of legal text for both the original and alternative solutions. This approach was proposed as futureproof (with options to cater for whichever decision was made for GC0139 by Ofgem), aiming to avoid a send back and save Industry time.

Grid Code Modification GC0103: The introduction of harmonised Applicable Electrical Standards in GB to ensure compliance with the EU Connection Codes – the Workgroup noted ongoing GC0103 work to introduce a harmonised electrical standard and advised that GC0168 consideration be made when tables in the General Conditions are being amended. Ongoing work to align electrical standards and what is published on the NESO website will capture this interaction.

What is the issue?

What is the defect the Proposer believes this modification will address?

As Great Britain's power System moves towards net zero carbon operation, connections to the network are transitioning from large synchronous generation to a larger number of smaller EPCs. This is causing new and varying challenges to the power System, especially in view of the different operating and performance characteristics of EPCs, whose power electronics interact with the NETS in a different way to older generation. Examples of these challenges include control interactions, low fault level, inverter instability and ToV.

NESO requires EMT models from Users so that it can analyse and understand how these interactions affect the NETS under different System conditions.

For some European Code Users, the demonstration of compliance requires EMT models to be provided and assessed through the Compliance Process. For Users subject to modification GC0141 'Compliance Processes and Modelling amendments following 9th August Power Disruption', the requirements for EMT model provision and the processes surrounding their provision have been clearly articulated. However, for GB Code Users (prior to the implementation of GC0141) there is currently no clarity over how these models should be made available.

Equally for early EU Code User's, the Grid Code does enable NESO to request EMT simulation where required (PC.A.6.1.3) however as with GB Code Users which have not been subject to the GC0141 process, there is no clarity over how these models should be made available. The requirements in the current Grid Code for these relevant Users require RMS models which are inadequate to accurately model the Transmission System with high proportions of EPCs. This situation arises through the complex switching sequences that EPCs introduce, therefore requiring a detailed three-phase representation through an EMT model. Therefore, to accurately represent the behavioural characteristics of the Transmission System, detailed EMT models will be required from Users.

Grid Code modification GC0141 (as approved by The Authority on 12 December 2022) already requires Users which either connected to the System after 01 September 2022 or were subject to a control system change or a modification to already supply an EMT model. In addition, Grid Code modification GC0102 'EU Connection Codes GB Implementation Mod 3' also enabled NESO to request an EMT Model from EU Code Users

where required. However, this modification (GC0168) is now seeking NESO to require relevant Users (which do not fall under the requirements of GC0141 or GC0102) to provide an EMT model on a retrospective basis where such a model is required.

Why change?

Unlike a System with a previously high penetration of synchronous generation which could be adequately analysed and studied with RMS models, an evolving System with a high penetration of EPCs requires more detailed EMT models to perform investigations and analysis. This is largely as a result of the complex switching arrangements that take place in EPCs unlike their synchronous counterparts.

The current requirements in the Grid Code are insufficient to cover the User data that NESO requires. As noted above, EMT models from Users are becoming essential to ensure that NESO can accurately model the Transmission System. Without these models, it restricts the ability of NESO to perform accurate System studies, modelling and post-fault analysis.

What is the solution?

Proposer's Original solution

The proposed solution is to mandate the provision of EMT models by Users with certain legacy assets with a completion date before 01 September 2022, upon request from The Company. A list of types of Users who will be affected by this proposed obligation can be found in **Annex 04**. The list of User types has been included within the proposed legal text (PC.A.9.2.2).

This solution will require updates to Grid Code Planning Code (PC) and an amendment to the Annex of the General Conditions (referenced in GC11) to introduce a new Electrical Standard which will indicate model requirements and the approach for retrospective submission.

These models will feed into a wider GB model enabling investigations, post fault studies and planning studies. This will help to enable safe, reliable and economic operation of the System and enhance the security of GB electricity supply.

WAGCM1 Solution

In relation to provision of EMT models by GB Code Users, the WAGCM1 Proposer considers it is essential that a compensation/cost recovery mechanism is directly acknowledged

within the solution. This was a core part of the Original proposal through Workgroup development of the original solution, and a core element of the implementation plan in the Workgroup Consultation.

The Original solution was amended to remove the above paragraph from the proposed legal text at the request of the Original Proposer, who now considers that GC0168 should be introduced as a stand-alone modification without the link to the CUSC and Bilateral Agreement.

WAGCM1 Introduces a deferred effective date for GB Code Users, allowing immediate effect for EU Code Users but delaying applicability to GB Code Users until cost recovery is in place within the CUSC.

Legal text

The legal text for the original solution and WAGCM1 can be found in **Annex 03** and **Annex 10**. The table below illustrates the difference between each of the solutions:

	Planning Code	General conditions
Original	Includes a requirement for Users to provide EMT models to NESO.	Updated to include a new Electrical Standard.
WAGCM1	Includes a link to cost recovery for legacy assets	None

Both sets of legal text have also been added to the proposed legal text for modification GC0139. If modification GC0139 is implemented ahead of GC0168, these sets of legal text can be used to implement GC0168. These sets of legal text are available in **Annex 11** and **Annex 12.**

The following considerations were taken into account when creating the legal text:

Original:

- Due to the retrospective nature of application of the Proposer's solution, which can be found in the proposed requirements, concerns attributed to the potential costs incurred resulting in retrospective requirements were raised by Users during several workgroup discussions, the Workgroup consultation and bilateral sessions.

- Several Workgroup members highlighted the need to introduce a mechanism in the Grid Code which could provide a guarantee that costs met by Users via their efforts to meet the proposed new, retrospective requirements would be reimbursed via the CUSC route.
- The original solution does not contain any guarantees that Users' costs will be recovered, neither is there a market mechanism in current arrangements to address this challenge. Users could be unfairly treated and in more extreme cases, consider closing some assets.

WAGCM1:

Two CUSC modifications (CMP456 and CMP466) have been raised to propose a cost recovery mechanism.

The two approaches below were considered by the Workgroup regarding drafting cost recovery for GC0168.

1. adding in a link to the (future) CUSC cost recovery mechanism, which would mean that GC0168 could not be implemented until the CUSC is amended; and
2. protection written into the legal text through deferring the obligation in relation to certain Users until a provision is available within the CUSC

Workgroup opted for option 2 and legal text was drafted accordingly. This can be found in **Annex 10**, (Section PC.A.9.2.2.2).

Workgroup considerations

The Workgroup convened 13 times in total to discuss the identified issue within the scope of the defect, develop potential solutions, and evaluate the proposal in relation to the Applicable Grid Code Objectives.

Consideration of the Proposer's solution

Legal text identified to be amended (Grid Code Planning Code)

During Workgroup discussions, members highlighted areas of the legal text that either needed clarification or to be changed.

Workgroup members agreed that a table should be included within the legal text to provide clear and structured information regarding the requirements for model provision, with the aim to:

- Distinguish between different types of connections and the specific dates and conditions under which models are required;

- Make it easy for readers to understand their obligations by presenting the information in a tabular format rather than in dense legal text; and
- Align the legal text with practical implementation details, such as the distinction between pre and post-September 2022 connections and the conditions for model updates after modifications.

This table has been included within Grid Code Planning Code, section PC.A.9.2.2.

Workgroup members discussed the use of the term mathematical models, emphasising the need to distinguish RMS and EMT models. They discussed the challenges of converting models between different software versions and the importance of validation. This has been clarified within the legal text.

The Proposer amended the legal text, which included technical clarifications and changes to specific sections of the Grid Code and shared this with Workgroup members for review.

Model collection timescales (Grid Code Planning Code, section PC.A.9.7.3)

Workgroup members raised concerns regarding the three-month timescale for sending validation reports to NESO in relation to model simulation results against measurements. Workgroup members agreed that more time was needed. The Proposer agreed to amend the text to state the 3 months would start after compliance testing had been completed.

Cost of model development and cost recovery

The Proposer noted that the Grid Code Review Panel (GCRP) had advised GC0168 Workgroup members to discuss and consider if a cost recovery mechanism was needed. Workgroup members agreed that there should be a cost recovery mechanism, but it was difficult to quantify as it would depend on the size of the unit, its age, type and if the manufacturer was still supplying equipment.

A NESO representative highlighted that cost recovery would apply to historical sites only and going forward this would be less of an issue, as new sites would not be eligible to claim.

Workgroup members agreed that a modification to the CUSC is required to introduce a cost recovery mechanism. CUSC modifications CMP456 and CMP466 have now been raised to propose a cost recovery mechanism.

Additional Term of Reference (ToR)

It was suggested by a NESO representative that an additional item was added to the ToR relating to the need to reflect international best practice. They suggested that the recent consultations relating to EU Requirements for Generators 2.0 (RfG 2.0) and High Voltage Direct Current 2.0 (HVDC 2.0) would provide an appropriate benchmark which was agreed

by the Workgroup. ToR (I) was approved by the Grid Code Review Panel. The ToR was amended to show the new reference.

Terms of Reference discussion

The Terms of Reference have been reviewed by the Workgroup to confirm that they have been met. The view of the Workgroup regarding the Terms of Reference is summarised as follows:

a) Implementation and costs

A Workgroup member noted that when Panel members agreed the ToR for the Workgroup, they were not aware of what the outcome would be.

Discussions have taken place, and members agreed that there is a need for a cost recovery mechanism. As funding is a commercial issue that technically falls outside the Grid Code, the issue would need to be addressed through a CUSC modification. The CUSC Panel and a CUSC Workgroup will consider the most appropriate cost recovery mechanism, especially noting that some parties affected by this change, for example owners of Licence Exempt Embedded Medium Power Stations (LEEMPS) are not CUSC Parties.

b) Review draft legal text

The legal text has been discussed thoroughly by Workgroup members and all comments and amendments have been considered by the Proposer. The amended legal text, which includes technical clarifications and changes to specific sections of the Grid Code, has been reviewed and agreed by Workgroup members.

c) Consider whether any further Industry experts or stakeholders should be invited to participate within the Workgroup to ensure that all potentially affected stakeholders have the opportunity to be represented in the Workgroup. Demonstrate what has been done to cover this clearly in the report

Two sets of nomination requests were issued to industry to encourage stakeholders to register for GC0168 Workgroups. Individual emails were also issued to equipment manufacturers to encourage their participation to Workgroups, this was done early in the process at the request of current Workgroup members.

The Proposer has engaged with owners of large Combined Cycle Gas Turbines (CCGTs) Units and/or Modules, who have been given the opportunity to review and contribute to this modification.

d) Consider Electricity Balancing Guideline (EBR) implications

It was agreed that there are no EBR changes, as there is no impact on the Balancing code.

e) Consider a cost recovery mechanism to receive the model data required to share with a CUSC Workgroup

Discussions have taken place in relation to the cost recovery mechanism, Workgroup members felt that the cost recovery mechanism was difficult to quantify as it would depend on the size of the unit, its age, type and if the manufacturer was still supplying equipment.

Workgroup members agreed that a CUSC modification will be required to implement a cost recovery mechanism. As a result, CUSC modifications CMP456 and 466 were raised.

f) Consider the use/introduction into the Legal Text of generator classification types C, D as opposed to Medium and Large

The use of User types was discussed in Workgroup meetings, the Proposer felt that the use of a list would be easier for users and more transparent. As currently drafted the legal text refers to Large, Medium and Small Power Stations as the contractual requirements are based on these terms. Following the implementation of the EU Requirements for Generators (RfG) in the GB Grid Code in 2018, technical requirements were specified based on Type A, B, C, and D Power Generating Modules as defined in the Grid Code. Although a Large, Medium or Small Power Station could comprise of any combination of Type, A, B, C, or D Power Generating Modules, the actual contractual obligation on the Generator under CUSC is with respect to the Power Station not the Power Generating Module, although it is true to say that under RfG most of the technical obligations are with respect to the Power Generating Module.

Noting that this GC0168 modification applies to all Generators, including GB Generators who are not caught by the requirements of RfG, the legal drafting (PC.A.9.2.2) has therefore been based on Power Station size (i.e. Large, Medium and Small) rather than Type A, B, C, and D Power Generating Modules.

g) Consider approach on collecting models and where that guidance would sit

This issue was discussed at the Workgroup, members agreed that additional guidance and the approach used could either be included as an appendix to the Planning Code in the Grid Code, under the relevant Electrical Standards, or as a standalone guidance note.

The Proposer suggested that including the guidance as an Electrical Standard would be the best approach as this does introduce a governance process (Grid Code GC11) around the document in a simple way. It was noted that if a bespoke appendix was added to the Planning Code, a full Grid Code modification would be required each time the document needed to be updated which would be demanding in terms of resource and time. It was also noted that a pure guidance note published on the NESO's website would be subject to no governance arrangements. Workgroup members agreed that neither of these

options would be desirable from an Industry perspective, and therefore the best approach would be to consider including the appropriate guidance as an Electrical Standard. A draft has been produced and content discussed extensively by workgroup members.

h) Consider codifying the list of Users who are required to submit EMT models

Workgroup members agreed this was considered and has been included in the proposed legal text under PC.A.9.2.2. which lists the User types who are required to submit an EMT model. See **Annex 04**.

i) Consider the scenario where a User is unable to provide an EMT model

This issue was discussed and the proposed legal text updated in PC.A.9.2.2.1 stating that where an EMT model is requested, this is required to be provided within 9 months of a request from NESO unless otherwise agreed in the case of a GB Code User, and 3 months of a request from NESO unless otherwise agreed in the case of an EU Code User. This wording also accounts for potential problems in preparing old plant EMT models that cannot meet all the requirements in PC.A.9. It should also be noted that for GB Code Users and early EU Code Users, a cost recovery mechanism is being introduced to provide a mechanism of compensating Users for the ability to supply a model when requested by NESO.

The difference in model submission timeframes between EU Code Users and GB Code Users arises through differences in treatment between EU Code Users and GB Code Users as introduced through the EU Connection Network Codes (RfG, Demand Connection Code (DCC) and HVDC Codes). Under the EU Connection Network Codes, there is a requirement for Users to provide an EMT Model when requested from the System Operator, however this is not the case for GB Code Users which accounts for the difference in approach between EU Code Users and GB Code Users. The draft legal text has addressed the challenges raised by workgroup members.

j) Consider whether there is a need for any consequential changes to the DCode and / or Distribution Connection and Use of System Agreement (DCUSA)

It was noted that it appears that a Distribution Code modification is unlikely to be required to ensure the technical requirements are adequately transferred to LEEMPS, and that there may be a need for a DCUSA modification to deal appropriately with LEEMPS in relation to any compensation mechanism that could arise from CUSC modifications CMP456 and CMP466.

It was agreed that the DCUSA administrator should be contacted and informed about this modification and Workgroup discussions. Contact was made with the DCUSA administrator in October 2025 to that effect.

k) **Consider whether there is a need to obtain EMT models from Medium Power Stations embedded in distribution networks and, if so, the mechanism for engaging with the host Distribution Network Operator (DNO) and the Generator and the process to be followed in the event that the Generator is unable to provide the EMT models or would incur significant costs in doing so**

This was discussed at Workgroup 4, and it was noted this was a particular concern as LEEMPS are not CUSC signatories but are bound by some of the requirements of the Grid Code Planning Code through obligations in the Distribution Code. The obligation for LEEMPS to comply with these requirements falls on the DNO, which the DNO would pass on to their LEEMPS customers through the connection agreement. However, as the LEEMPS would have no funding for the provision of the model under CUSC, this would be unfair if Generators with a CUSC contract were compensated.

l) **Consider if we are reflecting international practice including observation of the modelling developments proposed for RfG 2.0 and HVDC 2.0**

NESO advised that some additional requirements had been included in the proposed EU Connection Network Codes (e.g. RfG 2.0, DCC 2.0 and HVDC 2.0) relating to EMT models. It was suggested by NESO that these documents were reviewed with respect to their requirements on modelling to reflect international best practice. NESO has reviewed these documents, and the Workgroup has considered the impacts of these proposals.

Workgroup Consultation Summary

The Workgroup held their Workgroup Consultation between 23 January and 21 February 2025 and received 7 non-confidential responses and 2 confidential responses. The full non-confidential responses and a summary of the non-confidential responses can be found in **Annexes 05 and 06**.

Support for the requirement for users providing EMT models to NESO when requested:
Six respondents supported the implementation approach, including the requirement for Users to provide EMT models to NESO when requested, noting the importance of accurate power System modelling, including planning, operation, and post-event analysis.

- Most respondents noted that this support is conditional on a sufficient cost recovery mechanism being in place to allow for compensation for older Plants in particular, due to the significant cost of obtaining models.
- One respondent noted that it is reasonable to require Users to provide an EMT model, but the approach must consider the difficulties in obtaining models from legacy Plants.

- Two respondents noted that it is reasonable to require EMT models from Users identified in the draft legal text, but clarity is needed on which Users need to provide models by default, and which need to provide them when requested by NESO.

Workgroup feedback: Workgroup members agreed that the legal text must be clear on the process and obligations around model provision.

Non-support of the solution:
One respondent did not support the solution, noting that NESO needs to appreciate the significant cost involved in doing this for legacy Plants and the impacts of this cost, with the worst-case being closure of Plant.

Workgroup feedback: Workgroup members consider that providing Users with flexibility to make use of their existing RMS data will alleviate concerns around the implementation of this modification. It was noted that there is flexibility in the legal text to address practical challenges and timelines on a case-by-case basis. This will also be clarified within the Electrical Standard.

Cost recovery:
All of the respondents noted the need for a cost recovery mechanism, noting the following key points:

- Not having a cost recovery mechanism could lead to premature closure of older Plants.
- Having a cost-recovery mechanism in place before GC0168 is implemented is necessary to compensate parties who incur unexpected and significant costs as a result of providing models.
- A cost recovery mechanism is necessary to avoid discrimination against older Plants and potential non-compliance issues, including the need to apply for derogations.
- CUSC modification CMP398 'GC0156 Cost Recovery mechanism for CUSC Parties' was noted as a relevant example of cost recovery.
- Sites connected before September 2022 were not required to develop an EMT model by the Connection Agreement or Grid Code. A cost recovery mechanism is required because Users should not necessarily bear the cost of requirements introduced retrospectively by NESO.

Workgroup feedback: Workgroup members clarified that EU Code Users connected before September 2022 may still be required to provide EMT models if requested, as per the requirements of the EU connection network codes (RfG, HVDC).

Governance

Six respondents agreed it is appropriate to define the detail of the model submission in an Electrical Standard rather than in a specific part of the Grid Code, or as a separate guidance note.

- Respondents that preferred the model submission to be defined in an Electrical Standard noted its appropriate flexibility and that it would strike the correct balance between administrative burden and governance.
- Some respondents noted that ideally, everything should be in the Grid Code as a one-stop-shop for Code Users, however respondents acknowledge that they would support the use of Electrical Standards over guidance notes.

Workgroup feedback: Workgroup members agreed that the Electrical Standard will detail the process for model collection and submission, ensuring clarity and consistency.

Model submission method

Five respondents noted that it is appropriate for EMT models to be submitted in Power Systems Computer Aided Design (PSCAD) Version 5, however one raised concerns about future compatibility with newer software versions. One respondent noted that NESO should not define specific software, as it adds expense and complication.

Workgroup feedback: Workgroup members agreed that EMT models should be submitted in PSCAD Version 5, with considerations for future compatibility and flexibility in software choice.

Dealing with LEEMPS: There were mixed views around whether LEEMPS had been adequately dealt with within the Proposal:

- Two respondents noted that the Proposal does deal with LEEMPS adequately, requiring them to provide an EMT model where requested. However, both responses question how cost recovery will work, considering LEEMPS are not CUSC Parties. Another response also questioned this.

- Two respondents note that further clarification is required, as within the draft legal text, the arrangements for obtaining EMT models from a LEEMPS owner / operator is not clear.
- One respondent does not believe the proposal deals adequately with LEEMPS, stating that pre-September 2022 LEEMPS Generators should receive the same compensation as other Users.

Workgroup feedback: Workgroup members agreed that dealing with LEEMPS in terms of cost recovery is out of scope for the Workgroup and should be discussed within the CUSC modification which is to follow.

Target Implementation Date

Six respondents agreed with the proposed Implementation Date. However, the following concerns were raised:

- Consideration is needed for the timeline of associated CUSC, STC and potentially DCUSA modifications.
- One respondent does not believe the proposed timeline for Workgroup meetings and target date of September 2025 are reasonable, suggesting cost recovery mechanisms should be decided and implemented first.

Workgroup feedback: Workgroup members agreed that the implementation of this modification should be in line with the future CUSC modification relating to cost recovery and the implementation of modification CM097.

Workgroup Discussions following Panel Send Back

Following an initial Workgroup Vote (which has now been superseded by a second Workgroup Vote), the Workgroup Report was presented to the Grid Code Review Panel on 26 June 2025.

The Panel did not believe the Workgroup had met the modification Terms of Reference and did not agree for the modification to proceed to Code Administrator Consultation. The Panel referred the modification back to the Workgroup for further discussions and clarification on the following:

- Cost recovery, including a possible link to CUSC modifications CMP456 and CMP466.

- Legal text amendments and clarifications, including clarification on the interaction with the electrical standards and correction of grammatical errors.
- Reference to DCUSA within the interactions section of the modification.
- Possible derogation route – what happens if a model is not available and cannot be obtained or cannot be obtained within the timescales given.

Workgroup meetings were resumed on 17 December 2025. The Workgroup met 5 times to address the Panel feedback.

Cost recovery, including a possible link to CUSC modifications CMP456 and CMP466

Workgroup Debate on Cost Recovery Linkage to the CUSC and Legal Text Protection

The Workgroup held a detailed and robust debate on whether the technical Grid Code modification should progress independently of the associated commercial cost recovery arrangements.

The Proposer stated that the intention behind removing the explicit link to cost recovery was not to diminish User protections, but to prevent GC0168 being delayed by parallel commercial processes. The Proposer emphasised that GC0168 is a system-critical modification, necessary to enable effective EMT analysis and to support the secure and stable operation of the Transmission System.

A significant number of Workgroup members stated that they would not support the removal of the cost recovery linkage. They expressed strong concern that, in the absence of an established and enforceable compensation mechanism, Users could be exposed to substantial and potentially unrecoverable costs associated with the development of EMT models for legacy assets.

These Workgroup members considered that the inclusion of legal text explicitly linking the technical obligation to cost recovery was essential legal protection, rather than a procedural preference.

As a result, no consensus was reached. Workgroup members were unwilling to agree to the removal of the cost recovery linkage from the legal text without firm guarantees or legally binding assurances that costs incurred in complying with GC0168 would be recoverable. This position reflected a clear and deliberate decision by those members to prioritise legal certainty and protection against retrospective cost exposure.

It was communicated to the Workgroup by the Chair that under Grid Code governance the original Proposer was permitted to amend the original solution without agreement from the Workgroup. The Proposer determined that the link will be removed, and the final original solution does not contain a link to cost recovery.

Alternative Request (WAGCM1) raised, including a cost recovery link

The Chair advised the Workgroup that if Workgroup members wanted to proceed with the link to cost recovery, an alternative solution could be raised that could include a link to the CUSC, and that both options could be presented to the Authority for decision on which (if any) solution would be implemented.

WAGCM1 was raised by a Workgroup member on 12 December 2025. Full details of this alternative solution can be found in **Annex 09.** WAGCM1 was voted in by the Workgroup on 17 December 2025 by majority vote.

The WAGCM1 solution is similar to the original solution in all ways except the cost recovery link, which has been added to the proposed legal text (PC.A.9.2.2.2).

Workgroup discussion on WAGCM1 and corresponding legal text

The majority of Workgroup members explicitly welcomed the WAGCM1 solution, noting that it avoids placing GB code users at commercial risk and provides a pragmatic bridge between Grid Code obligations and the proposed CUSC implementation.

WAGCM1 was seen as consistent with pre-Panel send back Workgroup discussions and decisions.

The Workgroup discussed two potential implementation approaches for WAGCM1:

- Option 1: Aligning the effective date of GC168 EMT obligations with the availability of a CUSC cost-recovery mechanism.
- Option 2: Introducing a deferred effective date for GB Grid Code users, allowing immediate effect for EU Code users but delaying applicability to GB users until cost recovery is in place

The Workgroup favoured Option 2 for the alternative legal text. This option keeps GC0168 implementable now, while deferring NESO's obligation to request retrospective EMT models until appropriate cost-recovery arrangements exist within the CUSC. Members

felt this approach provides clarity on technical requirements without delaying the modification.

There was broad agreement that Option 1 would create unnecessary implementation delay and risk stalling progress.

The Workgroup also highlighted the need for legal drafting to reflect the new deferral mechanism clearly and requested that the scope be checked to ensure it captures all Users affected by retrospective application, not only those defined under a specific code classification.

A clause has been added to the proposed Legal Text (PC.A.9.2.2.2), stating that the process for NESO to request EMT models from Users for relevant Plant with a Completion Date (or commissioning date in the case of LEEPMS not subject to a Bilateral Agreement) on or before 01 September 2022 and which Plant has not been subject to a Modification or control system change, shall not apply unless and until a cost recovery process as described in CUSC modification proposal CMP456 is implemented.

The text 'unless otherwise agreed (such agreement not to be unreasonably withheld)' was added to the requirements regarding model submission for the above category of Users to provide flexibility and for further engagement with NESO where challenges to meet those requirements arose.

Legal text amendments and clarifications, including clarification on the interaction with the electrical standards and correction of grammatical errors.

Treatment of LEEMPS in Planning Code Legal Text

The Workgroup considered whether the existing Planning Code drafting, which places obligations on the "User", appropriately captures the technical and ownership realities of LEEMPS.

Workgroup members highlighted that, in many LEEMPS arrangements, the entity defined as the Grid Code "User" (i.e. the Network Operator) does not own, operate, or control the plant or equipment that determines dynamic performance or for which EMT models are required.

Workgroup members noted that in such cases, control of converters, firmware, and modelling capability typically sits with the Generator or original equipment

manufacturer, rather than the Grid Code user. The workgroup agreed that drafting obligations directly against the "User" risks placing legal requirements on parties who may not have the practical ability to comply.

Workgroup members also noted that LEEMPS assets frequently sit behind complex ownership and interface boundaries. Relevant equipment affecting EMT behaviour (including converters, transformers, and reactive compensation devices) may not align neatly with Grid Code interface points or User definitions. Several members expressed concern that "User"-based drafting could therefore create ambiguity over which assets are in scope and increase the risk of unintended non-compliance.

To address these issues, the Workgroup supported revising the legal text in certain clauses to refer to the "relevant plant or apparatus" rather than the "User". Workgroup members considered this asset-focused approach to better reflect the physical reality of LEEMPS arrangements by anchoring obligations to the equipment that gives rise to EMT behaviour, without prejudging contractual or organisational responsibility for submitting models. This approach was also seen as reducing ambiguity where ownership and control do not sit with the Grid Code User. The Proposer agreed to make these required changed to the proposed Legal Text.

The Proposer also agreed to explicitly clarify the LEEMPS position in the legal text, so there is no ambiguity about who submits models and in what circumstances this is done by the Network Operator on behalf of the Generator. Consideration was made in the updated drafting to reflect the challenges represented by LEEMPS. It was also noted that regarding modification to LEEMPS, DDRC5.3 and EREC G99 20.3.2 had provisions for change notifications to Network Operators, , but only for EREC G99 compliant LEEMPS. The Distribution Code requires a small modification to apply the requirements to LEEMPS connected under EREC G59.

Workgroup Discussion in the Interface Point definition (PCA 6.7)

The Workgroup discussed the use of the term Interface Point in the Planning Code, particularly in relation to LEEMPS.

Workgroup members noted that, for embedded assets, the Grid Code term Interface Point is inappropriate as it is defined in relation to Offshore assets. For Embedded Plant, NESO's modelling needs do not always align with ownership, control, or modelling responsibility. In many cases, generators cannot reasonably provide EMT models

beyond assets they own or control (e.g. upstream transformers or network equipment owned by a DNO, TO, or OFTO).

As a result, obligations framed solely by reference to a point remote from that party's relevant Assets risk extending requirements beyond what parties can practically deliver.

The workgroup expressed concern that relying on a point remote from that party's assets could create ambiguity over scope and responsibility, particularly where control of voltage or dynamic behaviour occurs at a different location from the formal interface definition. This was seen as increasing the risk of unintended non-compliance, especially for legacy LEEMPS.

To address this, members supported clarifying the point where obligations apply so they do not assume modelling responsibility for assets outside that party's control. This aligned with the wider agreement to use asset-focused drafting, referring where appropriate to the relevant plant or apparatus rather than relying on interface-point definitions to determine obligations.

The Workgroup agreed that references to interface point should not be used and supplemented or clarified so that EMT modelling obligations relate to the relevant Plant or Apparatus a party can reasonably control. The revised Planning Code text reflecting this approach was accepted by the workgroup.

Electrical Standard (EMT Modelling) – Summary of Workgroup Discussions

The Workgroup undertook a detailed review of the proposed Electrical Standard, with particular focus on its scope, structure, and suitability for application to both new and legacy assets. There was broad support for the principle of consolidating EMT modelling requirements within a formally governed Electrical Standard, noting that this would provide transparency, consistency, and appropriate governance, and would replace reliance on informal guidance material. This approach was also taken in response to stakeholder feedback at several Grid Code related forums which indicated concerns that guidance documents could be used to introduce requirements on Users.
Concerns were raised regarding the content and structure of the draft document. Workgroup members noted that parts of the draft, particularly sections describing collection processes and timelines, largely duplicated existing Grid Code obligations without adding clarity.

The Workgroup agreed that the Electrical Standard should avoid restating Grid Code requirements verbatim, but should instead add value by providing technical detail, explanatory material, and practical implementation guidance, especially where retrospective application to legacy Plant is required.

Regarding the treatment of legacy assets. Workgroup members emphasised that standards developed for new connections could not be applied retrospectively without flexibility, given constraints such as obsolete technology, unavailable OEM support, historic design choices, and software limitations.

The Workgroup agreed that the Electrical Standard must explicitly recognise these constraints and describe pragmatic or alternative approaches where full compliance with current EMT specifications cannot reasonably be achieved. These challenges are recognised in the draft.

Extensive discussion took place regarding 32-bit and 64-bit EMT models. Industry participants highlighted that many legacy assets, and some relatively recent ones, cannot readily provide 64-bit models. Concerns were raised that rigid requirements in this area could be impractical and create unnecessary barriers to compliance. The drafting of the Electrical Standard also addresses this issue. The Workgroup agreed that clearer drafting was required, including explicit recognition of legacy limitations and flexibility in acceptable approaches.

The Workgroup also discussed prioritisation and resourcing, noting concerns about the cumulative impact of multiple EMT model requests on OEMs, developers, and asset owners. Members sought greater clarity on how NESO would prioritise and sequence requests, particularly where multiple assets in the same geographic area may be affected. It was noted that, in such situations a phased approach to notification and submission will be followed to ensure an orderly and manageable process. These scenarios are also reflected in the draft Electrical Standard.

Language and terminology within the draft Electrical Standard were also scrutinised. Members expressed concern that terms such as “required” could be interpreted as introducing new obligations beyond those set out in the Grid Code. The Workgroup stressed the importance of careful drafting to ensure that the Electrical Standard supports, but does not extend or unintentionally amend, Grid Code obligations.

Interactions with DCUSA

The Workgroup discussed DCUSA as a potentially impacted Industry Code. A requirement to submit EMT models by Embedded Medium Power Stations not subject to a Bilateral Agreement (Data to be provided by relevant Network Operator to NESO) arose from this Modification.

The Proposer engaged the DCUSA Administrator in October 2025 and informed them about this ongoing work and requested for audience to discuss progress of GC0168 and potential DCUSA interactions.

Possible derogation route – what happens if a model is not available and cannot be obtained or cannot be obtained within the timescales given.

The drafting of PC.A.9.2.2 was agreed by the Workgroup as providing the solution to this challenge. Chapter 5 in the draft Electrical Standard also added detail on potential approaches to develop legacy Plant model recognising the challenges that Users will encounter in developing EMT models for this Plant.

Primary challenges noted include a) lack of data, b) obsolete technology, c) compatibility issues and d) original design versus current regulatory requirements.

The Electrical Standard can be found in **Annex 08**.

GC0139 interaction

Due to the interaction with GC0139, which could be implemented ahead of GC0168, the Workgroup proposed that two sets of legal text for both the original and alternative solutions. This approach was proposed as futureproof (with options to cater for whichever decision was made for GC0139 by the Regulator), avoid a send back by Ofgem and save Industry time.

Terms of Reference Overview

a) Implementation and costs The majority of Workgroup members noted that they would not support this modification unless an appropriate cost-recovery mechanism is in place.
b) Review draft legal text Legal text for both solutions have been reviewed and agreed by the Workgroup, including versions that can be used should modification GC0139 be implemented ahead of GC0168.
c) Consider whether any further Industry experts or stakeholders should be invited to participate within the Workgroup to ensure that all potentially affected stakeholders have the opportunity to be represented in the Workgroup. Demonstrate what has been done to cover this clearly in the report. Good representation in the Workgroup from all sections of the industry.
d) Consider EBR implications The Workgroup agrees there is no impact on EBR.
e) Consider a cost recovery mechanism to receive the model data required to share with a CUSC Workgroup. CUSC modifications CMP456 and CMP466 have been raised by a GC0168 Workgroup member to consider cost recovery within the CUSC.
f) Consider the use/introduction into the Legal Text of generator classifications types C, D as opposed to Medium and Large. Discussed during the Workgroup and agreed that it would add unnecessary complexity to add these definitions.
g) Consider approach on collecting models and reference to published guidance/phased application of approach. The Workgroup has agreed on a new Electrical Standard, which details the process of model collection.
h) Consider codifying the list of Users who are required to submit EMT models. Completed and included within the draft legal text.

i) Consider the scenario where a User is unable to provide an EMT model. The drafting of PC.A.9.2.2 was agreed by the Workgroup as providing the solution to this challenge.
j) Consider whether there is a need for any consequential changes to the DCode and / or DCUSA. The Proposer engaged the DCUSA Administrator in October 2025 and informed them about this ongoing work and requested for audience to discuss progress of GC0168 and potential DCUSA interactions.
k) Consider whether there is a need to obtain EMT models from medium power stations embedded in distribution networks and, if so, the mechanism for engaging with the host DNO and the Generator and the process to be followed in the event that the Generator is unable to provide the EMT models or would incur significant costs in doing so. CUSC modifications CMP456 and CMP466 have been raised by a GC0168 Workgroup member to consider cost recovery within the CUSC.
l) Consider if we are reflecting international practice including observation of the modelling developments proposed for RfG 2.0 and HVDC 2.0 Considered by the Workgroup and included within the Workgroup Report.

What is the impact of this change?

Proposer's assessment against Grid Code Objectives	
Relevant Objective	**Identified impact**
(i) To permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity	**Positive** EMT models will be required to carry out analysis such as system oscillation, inverter stability, ToV analyses, especially noting that EPCs require a more detailed model than that available

	from a current RMS representation. Without being able to conduct this type of analysis using EMT models, it could lead to unnecessary investment by Users or TOs, significant increase in constraint costs, single events leading to tripping of a number of generators and could ultimately lead to loss of supply.
(ii) Facilitating effective competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity);	**Positive** As new generation technologies connect to the network, most of which will rely on power electronic converters, more detailed models will be required not only in respect of the new generation itself but also the impact they have on existing generation. This will drive greater impact on competition.
(iii) Subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole;	**Positive** Due to the increase in EPCs connecting to the grid which is in line with the UK government's Net Zero ambition, this modification will enable a greater volume of EPCs to connect whilst ensuring a more thorough

	evaluation of the source of oscillations or disturbances and to plan mitigating actions.
(iv) To efficiently discharge the obligations imposed upon the licensee by this licence* and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency; and	**Positive** EMT analysis is important for investigating the dynamics of converters and control interactions with the System, which enables the NESO to meet its licence obligations.
(v) To promote efficiency in the implementation and administration of the Grid Code arrangements	**Positive** At the moment, NESO has a need for analysis to be done, and in many cases the obligations for that analysis are on new entrants in the first instance, without the data to support the analysis. Then beyond that we have requirements to support the planning and operation of the system which are lacking these same models. This modification will give NESO access to models of already connected Plants.

**See Electricity System Operator Licence*

Proposer's assessment of the impact of the modification on the stakeholder / consumer benefit categories	
Stakeholder / consumer benefit categories	**Identified impact**
Improved safety and reliability of the system	**Positive** When generators provide EMT models to the NESO, it will be able to carry out pre-fault and post-fault analysis studies, the outputs of which will lead to accurate operational decisions in the interest of safety and reliability of the system which could ultimately lead to lower operational costs for the benefit of the end consumer.
Lower bills than would otherwise be the case	**Positive** More accurate models will enable greater Transmission System optimisation which would have the benefit of reducing consumer bills.
Benefits for society as a whole	**Positive** More accurate models will enable greater Transmission System optimisation and reduce the need to run other Plant to compensate for inaccurate models.
Reduced environmental damage	**Positive** More accurate models will enable greater Transmission System optimisation and a reduced need to run other Plant, some of which could be carbon based which will have a positive environmental impact.
Improved quality of service	**Positive** More accurate models provide greater optimisation resulting in lower bills and therefore improving quality of service.

First Workgroup Vote

The Workgroup met on 09 May 2025 to carry out their Workgroup Vote. The Workgroup concluded by majority that the Original better facilitated the Applicable Objectives than the Baseline.

This vote was superseded by a second Workgroup Vote following the Panel send back.

Second Workgroup Vote

The Workgroup met on 24 March 2026 to carry out their second Workgroup Vote. The Workgroup concluded by majority that the Original better facilitated the Applicable Objectives than the Baseline.

For reference the Applicable Grid Code Objectives are:

i. *To permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;*
ii. *Facilitating effective competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity);*
iii. *Subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole;*
iv. *To efficiently discharge the obligations imposed upon the licensee by this license* and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency; and*
v. *To promote efficiency in the implementation and administration of the Grid Code arrangements.*

** See Electricity System Operator Licence*

The Workgroup concluded by majority that WAGCM1 better facilitated the Applicable Objectives than the Baseline. The Workgroup did not agree that the original solution better facilitated the Applicable Objectives than the Baseline.

Option	Number of voters that voted this option as better than the Baseline (out of 7 votes)
Original	3
WAGCM1	6

When will this change take place?

Implementation Date

10 Business Days following Authority decision.

Date decision required by

As soon as practicable.

Implementation approach

No systems will have to change as a result of this modification.

Interactions

☒CUSC	☐BSC	☒STC	☐SQSS
☐European Network Codes	☐ EBR Article 18 T&Cs[1]	☐Other modifications	☐Other
☐ DCODE	☒DCUSA		

Two CUSC modifications have been raised relating to a cost recovery mechanism:

CMP456: Cost recovery for legacy plant in relation to GC0168

CMP466: CMP456 Consequential Charging Modification

DCUSA: DCUSA Change team has been contacted to consider interactions.

Corresponding STC modification CM097 – Electromagnetic Transient (EMT) and Root Mean Square (RMS) Model Submission for Transmission Owners (TOs).

STCP modification PM0147 has been raised to introduce a new System Operator-Transmission Owner Code Procedure (STCP) 12-2.

A new Electrical Standard will go through the governance process in the General Conditions (GC11) following an Authority decision.

[1] If the modification amends any of the clauses mapped out in Annex GR.B of the Governance Rules section of the Grid Code, it will change the Terms & Conditions relating to Balancing Service Providers. The modification will need to follow the process set out in Article 18 of the Electricity Balancing Regulation (EBR – EU Regulation 2017/2195). All Grid Code modifications must be consulted on for 1 month in the Code Administrator Consultation phase, unless they are Urgent modifications which have no impact on EBR Article 18 T&Cs. N.B. This will also satisfy the requirements of the NCER process.

How to respond

Code Administrator Consultation questions

- Please provide your assessment for the proposed solution(s) against the Applicable Objectives versus the current baseline.
- Do you have a preferred proposed solution?
- Do you support the proposed implementation approach?
- Do you have any other comments?
- Do you agree with the Workgroup's assessment that the modification does not impact the Electricity Balancing Regulation (EBR) Article 18 terms and conditions held within the Code?

Views are invited on the proposals outlined in this consultation, which should be received by **5pm** on **08 June 2026**. Please send your response to grid.code@neso.energy using the response pro-forma which can be found on the modification page.

If you wish to submit a confidential response, mark the relevant box on your consultation proforma. Confidential responses will be disclosed to the Authority in full but, unless agreed otherwise, will not be shared with the Panel or the industry and may therefore not influence the debate to the same extent as a non-confidential response.

Acronyms, key terms and reference material

Acronym / key term	Meaning
BSC	Balancing and Settlement Code
CCGT	Combined Cycle Gas Turbine
CMP	CUSC Modification Proposal
CUSC	Connection and Use of System Code
DCC	Demand Connection Code
DCUSA	Distribution Connection and Use of System Agreement

DNO	Distribution Network Operator
EBR	Electricity Balancing Regulation
EMT	Electromagnetic Transient
EPC	Electronic Power Converter
GCRP	Grid Code Review Panel
HVDC	High Voltage Direct Current
LEEMPS	Licence Exempt Embedded Medium Power Stations
NESO	National Energy System Operator
OEM	Original Equipment Manufacturer
PSCAD	Power Systems Computer Aided Design
RfG	Requirements for Generators
RMS	Root Mean Square
SQSS	Security and Quality of Supply Standards
STC	System Operator Transmission Owner Code
STCP	System Operator-Transmission Owner Code Procedure
TO	Transmission Owner
ToR	Terms of Reference
ToV	Transient Overvoltage
T&Cs	Terms and Conditions
WAGCM	Workgroup Alternative Grid Code Modification

Annexes

Annex	Information
Annex 01	GC0168 Proposal Form
Annex 02	GC0168 Terms of Reference
Annex 03	GC0168 Legal Text
Annex 04	GC0168 List of types of Users required to provide EMT models
Annex 05	GC0168 Workgroup Consultation Summary
Annex 06	GC0168 Workgroup Consultation Responses
Annex 07	GC0168 Second Workgroup Vote
Annex 08	GC0168 Proposed Electrical Standard - EMT Modelling Requirements and Process for Submitting EMT Models
Annex 09	GC0168 WAGCM1 Proposal Form
Annex 10	GC0168 WAGCM1 Legal Text
Annex 11	GC0168 Original Legal Text adjusted for GC0139 Implementation
Annex 12	GC0168 WAGCM1 Legal Text adjusted for GC0139 Implementation
Annex 13	GC0168 Workgroup Attendance Record
Annex 14	GC0168 Workgroup Action Log