Annex 5 - Subgroup Discussions and Terms of Reference

As outlined, workgroup discussions highlighted divergent views on some fundamental aspects of the proposed original solution and, given the complex nature of these areas, the workgroup agreed to form 3 subgroups to discuss potential alternative solutions and whether to raise them as formal alternative proposals. These alternative areas of discussion related primarily to the following topics:

- Requirement for Independent Engineer verification
- Interoperability
- Modelling Appendix 9

Several alternative solutions were raised for further discussion with the workgroup and details may be seen in the Post Workgroup Consultation section of the main document.

Independent Engineer Discussion

Potential revisions of wording around stipulations for the Independent Engineer and associated role specifics. The concept of "Independent" was to be reviewed along with consideration of whether a guidance note may be required.

Initial discussions resulted in the view that whilst the Original meets the objectives of the Grid Code, it is believed that an alternative solution could offer additional advantages to The Company and the User

Key discussion areas included:

- **Defining the role and skill set required**
    - Focus on the skills required to provide the functionality, ensuring those conducting the role have no conflict of interest - leading to greater opportunity for cost effectiveness and lower cost to consumers. The group noted that a range of entities inclusive of independent entities within the User base, and the ESO and TOs may be considered, which would limit additional cost of execution. Confirmation would be required that the terms of reference are met, and appropriate skills and resourcing are present.
- **Clarifying the process and responsibilities**
    - To ensure a smoother, more efficient process for the Company and the User. This clarity also allows the relevant resources to be identified and combined by the User to fulfil the role on a project by project basis.
- **Suggested Terms of Reference for the role**
    - Maintain a list of interests and ensure that delivery of the review and recommendations is objective and technically focused. The list is used for User evaluation and Company consultation ahead of being appointed.
    - Responsible for review and comment on the scope of analysis to be conducted to satisfy Grid Code and Bilateral Connection Agreement requirements. Comment on the fitness of data and models that form part

of this process, highlighting any gaps and providing a view on assumptions being taken.
    - Review of the analysis reported on and provide specific recommendations on acceptability and or completeness in meeting the scope of the compliance activities.
    - Provide resource supporting the User's agreed programme of compliance activity and The Company's associated activities, provide timely feedback. If the outcome of the review impacts the compliance process programme the User shall inform the Company.
    - Manage confidentialities involved in discharging the above, in particular in the exchange of models and simulation results.
    - An Independent Engineer is not expected to redo the simulation studies (unless agreed by the User and ESO) but should provide technical feedback on the validity of study assumptions, study approach and results.
    - The User should maintain a clear auditable record of its interaction with the compliance process.
- **How to deliver against Terms of Reference**
    - Clear definition of scope of the project under review
    - Complete, accurate and timely assessment of data from the Company or User being used to inform compliance activities, including those requiring suitable confidentiality management within the project.
    - Access to the program and milestones associated with the compliance process
    - Access to all relevant meetings/ minutes/ discussions related to the compliance activities under review
- **Need for a guidance note – to cover**
    - Aiding the User and avoiding overly detailed and burdensome legal text
    - Scope of the independent engineer i.e. template Terms of Reference and The Company's expectations to ensure consistency.
    - Responsibilities/liability of the independent engineer and their credentials/experience
    - Examples of typical information required to discharge duties correctly, e.g. case studies.
    - Studies not directly related to CP, ECP or OC5 e.g. harmonic studies, multi-infeed studies etc.
    - Dispute resolution procedures e.g. in the event of disagreements or failure to approve tests being considered unreasonable
    - How the independent engineer fits into the interface between The Company and the User.
    - Process and timeline for onboarding and offboarding into/out of a project.
    - With respect to point 5 in the legal text provide an example of a sign off sheet
    - Provide non-exhaustive examples of what may require Independent Engineer review during self-certification of the Grid Code compliance process. Consideration shall be given to the substantial modification process with the ESO; this could be either large replanting or a cumulative effect of a number of smaller modifications.

Interactions SSCI/SSTI - Alternative

To discuss undue interactions such as SSCI and SSTI, responsibilities for various parties (as part of a connection), and signal disturbance. The group also reviewed the process concerns, and responsibility concerns.

An alternative in this area would address the following areas:

- Clearly defined roles and responsibilities with respect of The Company providing both data relating to the screening process which precedes interaction and the interaction study itself which can be summarised as;
    - The Company should use UIF techniques and other data such as knowledge of the scope of harmonic transfer impedances used to define a project's harmonic background, and the extent to which projects are dynamically contributed in classical RMS studies to define both the study area and the range of operating cases a User should then consider within those studies.
    - The User is responsible for capturing the full extent of their connection in appropriate models suitable for the study and the range of operating conditions across which the User's connection could be subject to, and then within the network models provided assessing relevant forms of interaction in suitable models or other tools appropriate to the form of analysis.
    - Consistent with historic analysis of interaction (for example Power System stabiliser design), it is recognised the above may not represent a complete description of all of the analysis necessary. The Company in receipt of both the User-relevant models and its own relevant models is responsible for ensuring any broader planning considerations which arise from consideration of the User's solution in a larger network model are reflected back to the user and that suitable solutions are found to address these considerations, which may include further discussions regarding User measures if more efficient and economic than other alternatives.

- Defining the processes of small signal stability assessment which combined with frequency scanning techniques can effectively identify a range of focused areas for further EMT dynamic simulation, thus avoiding hunting for "needles in a haystack" (as EMT studies are dependent on a much greater range of variables to classical RMS studies across which it is harder to identify interaction risk and verify solutions to it without analysis focused in different areas to just classical RMS techniques). Such frequency domain analysis may also provide sufficient information to provide assurance that SSTI and related SSO considerations at a given frequency include sufficient electrical and minimum mechanical damping (where such assumptions are available and relevant). In summary, such small signal techniques would need to be enabled in the following manner:
    - Each User should accompany its EMT model with a suitable suite of "Z plots"; frequency dependent impedance representations of power electronic converter connections across each of the relevant operating conditions for which these plots differ. Such plots shall be constructed

by small signal techniques which capture the effect of relevant control and protection within the frequency domain, including the effects of both PPS and NPS control loops for give operating points and control modes. Such a Z plot should be detailed in a minimum of 0.5Hz increments between a minimum 0->200Hz, enlarged to include any other relevant frequencies as identified from other harmonic analysis where this is identified from other analysis The Company has access to from network planning activity associated with the connection.
    - The User conducting a frequency scan should similarly construct its Z plot from its EMT model following the above principles.
    - In order to support a connecting User undertaking a small signal interaction analysis, whether for SSTI or other reason, the User should for the network area it presents and the relevant operating points of it and the connected sources, also provide the relevant Z plots of other Users that correspond to those conditions enabling the associated analysis. For example we note the tendency for existing SSTI process to "jump" from a UIF measure which may be increasingly of limited relevance to modern forms of converter connection, to a dynamic simulation reflecting UIF considerations only and requiring additional shaft data - whereas correct use of small signal analysis may provide assurance without need for such shaft data, or otherwise where that assurance is insufficient at least better direct further dynamic simulation incorporating shaft information.
- Clear definitions consistent with CIGRE B4.81 recommendations (Annex 2 refers), in order to ensure that:
    - The necessary simplifications within EMT models as provided are oriented towards being fit for the defined purpose of the defined form of analysis intended.
    - The range and applicability of platforms for such analysis (offline EMT, real time analysis, real time Control & Protection Hardware in the Loop) is clear in relation to the definitions of study.
    - It should be clear at the outset of the detailed design phase of a project: the extent of analysis required, the formats of data exchange needed to support the analysis areas required and agreement on the appropriate analysis platforms to conduct them. In particular we note that control and protection hardware in the loop where required drives additional modelling and hardware that requires early definition to be delivered efficiently.
- With respect to current drafting the subgroup noted that The Company "may specify" Real time analysis for example with respect to protection. The recommendation was that with reference to the above definition this is made clearer that The Company "shall" where required by the definition of the required analysis both require and further justify real-time analysis ahead of the detailed design phase of a project.

RMS and EMT Modelling Appendix 9 Alternative

Discussions to consider interactions with interoperability challenges, use and sharing of models, simplification of the RMS model, validation of models against each other

and consequence of simplification, technical buildup of models (criteria), future proofing, format and sharing of models

The group concluded that while the Original text provides a much-needed foundation for the development of the RMS and EMT control system models, the complexity of developing, updating and distributing such models requires some additional clarity and further detail to provide a more practical set of requirements and reduce the volume of project-level clarifications required.

Key discussion areas and outcomes are as follows:

- **Distribution of models**
  - Clarification is needed on the use of the models at the System Operator level (e.g. assess the transient performance, security and stability of the transmission System) as well as their distribution to other Users that must require the models for the purposes of Grid Code compliance and related studies. Additionally, Intellectual Property rights of the manufacturers need be protected while still ensuring the points above can be effectively addressed. In this regard, a separation of the distribution requirements for the simplified RMS models and detailed encrypted EMT models would be seen as necessary based on their use and the studies to be executed by the relevant stakeholders. Additionally, the repository for the models (e.g. the Joint Planning Committee) should also be noted within any alternative
- **Simplification of the RMS model which doesn't use proprietary blocks or code**
  - Assessment is required on model performance where it would be impacted by the necessary simplification and proposed increased simulation time step of 10ms. The intention is not to specify a certain level of accuracy for the “simplified” model but to clarify that certain areas of the model and its subsequent performance (e.g. fault-infeed, TOV and/or fault recovery) may be affected. This will also impact the validation of models against EMT or RTDS results and expectations on accuracy. Overall, these impacts would require an assessment by The Company and User (and Independent Engineer where relevant) to determine how these areas are addressed such that the RMS model can be used for planning purposes without giving a falsely optimistic view of performance that could lead to EMT studies not being initiated at times when they would be advisable. The alternative to the above would be to provide an as-built proprietary RMS model representing the User system accurately.
- **Clarification of black-boxing wording to ensure consistency with industry**
  - Additionally, the issue of futureproofing and formatting of the models needs to be addressed in this context.
- **Rewording of PC.A.9.8 and PC.A.9.9 to facilitate practical implementation**
  - Parts of these sections may be better suited to a guidance document.