Paper to the Grid Code Review Panel

GC0077 Suppression of Sub-Synchronous Resonance from Series Capacitive Compensation

Responses to Consultation and Next Steps

by Graham Stein, National Grid

11 September 2014

Background

GC0077 was raised by John Morris at the September 2013 Grid Code Review Panel[i]. National Grid representatives were asked to draft a consultation document incorporating points and issues raised by Panel members.

Consultation

A draft consultation was presented and discussed at the January 2014 GCRP meeting[ii]. The consultation proposed the inclusion of two new paragraphs in the Connection Conditions to specify that NGET, and the other Transmission Licensees, will ensure that Users' Plant and Apparatus will not be subject to unacceptable sub-synchronous conditions and that any site specific conditions are set out in Users' Bilateral Agreements. Panel members were asked to provide their comments on the draft consultation.

The consultation document also explained how Section D paragraph 2.2.6 of the System Operator Transmission Owner Code (STC) places an obligation on Transmission Owners to discharge obligations in named sections of the Grid Code. As the new proposed Grid Code text was within CC6.1, a Grid Code section already listed in the STC, the new requirements would apply equally to all transmission licence areas. No changes were proposed to the STC.

The consultation also highlighted that the SQSS Panel intended to examine proposals to change the Security and Quality of Supply Standard to deal specifically with sub-synchronous issues and provided the example of system stability as a an example of how sub-synchronous oscillations could be dealt with. The modification proposal GSR018 was discussed at the April SQSS Panel meeting where it was agreed to form a workgroup. The GSR018 workgroup[iii] is scheduled to have its second meeting on 3 October.

The Grid Code consultation GC0077 was published on 17 July 2014 with responses requested within a period of 20 Working days.

Discussions at the GCRP had included reference to the provisions in Section 6 of the Connection and Use of System Code (CUSC). These provisions determine how new connections, changes to connections and changes to the transmission networks which affect Users are managed. They had been described in previously approved proposals concerning Sub-Synchronous Resonance (GC0040[iv]) but were not described in the GC0077 consultation. The CUSC provisions are relevant because of the way that one party's decision to install equipment (eg series compensation) can have an impact on another party's exposure to sub-synchronous oscillation risks.

The consultation closed on 15 August at which point five responses had been received. Support for the proposed changes varied amongst the responses. One response did not support the proposals. The responses are provided in full in the Appendix to this paper. The main points raised are summarised below.

Responses to the Grid Code Consultation

Two responses stated that the proposals could not be deemed to be effective in the absence of the development of the SQSS.

One response proposed that Transmission Users should be able to determine the criteria by which "unacceptable sub-synchronous oscillations" should be defined and that a requirement to install torsional vibration monitoring (with appropriate funding arrangements) should be added.

Another response suggested it may be useful to add text to make explicit reference to new Users' responsibility compared to existing Users where a modification is concerned, whilst recognising the complexities of drafting this effectively.

One response stated that the proposals create new risks and costs for Users.

Next Steps

There are a number of possible ways forward. The table below provides a non-exhaustive list of 5 options with arguments for and against for the Grid Code Review Panel's consideration.

	Options	Argument for	Argument Against
1	Implement Proposals as Drafted	• Majority of respondents believe they better facilitate Grid Code objectives • Establishes obligations to manage SSO • Could be reviewed upon SQSS WG conclusion	• Does not address concern over new risks and Costs for Users and suggestions for improvement
2	Revisit following conclusion of SQSS Workgroup	• Would allow a complete package of proposals to be reviewed once the SQSS WG had concluded	• Delays resolution
3	Develop proposals at GCRP	• Potential to address concerns and address perceived defect	• Insufficient time at Panel to fully discuss and develop effective proposals
4	Create a Grid Code Workgroup	• Allows sufficient time to address issue	• Delays resolution • Interaction with SQSS Workgroup
5	Ask SQSS Workgroup to develop proposal	• Efficient use of expert resource	• Delays resolution • Governance to be defined

[i] Issue Paper:
http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=27870

[ii] January 2014 Grid Code Review Panel Meeting Information:
http://www2.nationalgrid.com/UK/Industry-information/Electricity-codes/Grid-code/Panel-information/Meetings/2013/15-January-2014/

[iii] Modification proposal and workgroup terms of reference for SQSS WG GSR018:
http://www2.nationalgrid.com/UK/Industry-information/Electricity-codes/SQSS/Modifications/GSR018/

[iv] GC0040 Report to the Authority:
http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=14735

Grid Code Industry Consultation Response Proforma

GC0077 Suppression of Sub-Synchronous Resonance from Series Compensators

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses by **15 August 2014** to Grid.Code@nationalgrid.com. Please note that any responses received after the deadline or sent to a different email address may not receive due consideration.

These responses will be included in the Report to the Authority which is drafted by National Grid and submitted to the Authority for a decision.

Respondent:	*Andy Vaudin* *andrew.vaudin@edfenergy.com*
Company Name:	*EDF Energy*
Do you believe the proposals provide sufficient clarity and transparency to Transmission Users on how Sub-synchronous Resonance, Sub-synchronous Torsional Interaction and related phenomena will be managed where Transmission Licensees are installing new equipment?	*The proposals do not provide sufficient clarity and transparency:* • *The proposed CC.6.1.9 refers to unacceptable sub-synchronous oscillation conditions as specified in the relevant Licence Standards. As the Licence Standards have not yet been developed, it is not possible to be certain that NGET will have to ensure that User's Plant is not subject to unacceptable conditions for all future network configurations and conditions. There is a concern that the Licence Standards could be restricted to a certain range of network conditions. For areas where the Transmission Licensee has opted not to install Thyristor Controlled Series Compensation, this could lead to the User having to install generator protection and monitoring equipment to mitigate the risk of SSR with network conditions falling outside of those included within the Licence Standards.* • *It is noted that the existing CC.6.3.16(a) places a requirement on DC Converters to install SSR damping control facilities. It would be expected that a similar requirement should be placed on Transmission Licensees installing Series Capacitive Compensation equipment.* • *The inclusion of proposed CC.6.1.10 removes the clarity and transparency on how SSR interactions will be managed. It is*

	left unclear whether the Licensee and NGET will fully mitigate the risk for all network conditions and configurations, by installation of appropriate damping, or whether the onus will be placed on the User to mitigate the risk with an obligation to install generator protection and monitoring added to the BCA.
Have you identified any adverse, perhaps unintended, consequences of the proposals? If so what are they, and how should the proposals be improved?	*Referring to the replies to the question above, the adverse consequences of the proposals are:* • *A part of the responsibility to mitigate the risk of SSR would shift from the Transmission Licensee installing the Series Capacitive Compensation equipment, onto the Users; particularly in areas where the Transmission Licensee has opted not to install Thyristor Controlled Series Compensation. The clear responsibility should be for the Transmission Licensee and NGET to design, install and operate the system without causing additional risk or cost to Users.* • *The proposals would lead to the requirement for Users to install generator protection and monitoring equipment, with associated installation and operation costs. There could be an increased risk of "nuisance" trips of User's plant from SSR generator protection*
Do you support the proposed implementation approach?	*The proposed implementation approach of additional clauses to the Grid Code is supported. However, the proposed text is not supported nor the references to future, as yet undefined, Licence Standards.*

Do you believe that GC0077 better facilitates the appropriate Grid Code objectives?	*(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;* The proposals do not yet provide sufficient clarity. See response to questions above. *(ii) to facilitate 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);* The proposals do not make it clear on the responsibilities for mitigation of SSR risk. *(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; and* The proposals do not make it clear on the responsibilities for mitigation of SSR risk. *(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.* *Neutral*
Please provide any other comments you feel are relevant to the proposed change.	

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Respondent:	*Guy Phillips (guy.phillips@eon-uk.com)*
Company Name:	*E.ON UK plc*
Do you believe the proposals provide sufficient clarity and transparency to Transmission Users on how Sub-synchronous Resonance, Sub-synchronous Torsional Interaction and related phenomena will be managed where Transmission Licensees are installing new equipment?	*Broadly yes, we would question whether it is necessary in the proposed new clause CC6.1.10 when referencing User's whether it needs to be more explicit regarding the responsibilities of a new User compared with an existing connected User and any conditions around plant modification. This may become too complex to draft, and would be better by appropriate changes being reflected in User's Bilateral Agreements as the text proposes. Recognition of the principle in the text that a new user should not impose additional costs on an existing user and equally any change made by an existing user that affects another existing user, should be at the party who is making the change cost, would be helpful. Ordinarily we would expect this to be reflected in the Third Party Works provisions of an associated Modification Offer.*
Have you identified any adverse, perhaps unintended, consequences of the proposals? If so what are they, and how should the proposals be improved?	*No.*
Do you support the proposed implementation approach?	*Yes.*

Do you believe that GC0077 better facilitates the appropriate Grid Code objectives?	*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) to facilitate 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; and* *(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.* *We support the reasons given in the consultation. In relation to objectives ii) and iii) we would add that the proposal should help to ensure that costs are borne by the most appropriate party in managing Sub-synchronous Resonance, Sub-synchronous Torsional Interaction and related phenomena.*
Please provide any other comments you feel are relevant to the proposed change.	*We do not have any additional comments.*

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Respondent:	*Please insert your name and contact details (phone number or email address)* **Philip Belben** **philip.belben@horizonnuclearpower.com** **Dave Draper** **dave.draper@horizonnuclearpower.com**
Company Name:	*Please insert Company Name* **Horizon Nuclear Power**
Do you believe the proposals provide sufficient clarity and transparency to Transmission Users on how Sub-synchronous Resonance, Sub-synchronous Torsional Interaction and related phenomena will be managed where Transmission Licensees are installing new equipment?	**No. NGET must ensure that no user experiences "unacceptable" sub-synchronous oscillations. What constitutes "unacceptable" is to be defined in the Licence Standards, but the proposals here do not suggest any limits for incorporation in those standards. This potentially makes the changes totally ineffectual.**
Have you identified any adverse, perhaps unintended, consequences of the proposals? If so what are they, and how should the proposals be improved?	**No adverse consequences have been identified.**
Do you support the proposed implementation approach?	**Yes, provided the necessary changes to the Licence Standards can be discussed and agreed in time.**

Do you believe that GC0077 better facilitates the appropriate Grid Code objectives?	*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;* **Yes** *(ii) to facilitate 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);* **Yes** *(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;* **Yes** *and* *(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.* **Yes**
Please provide any other comments you feel are relevant to the proposed change.	

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Respondent:	John Norbury Network Connections Manager RWE Supply & Trading GmbH Windmill Hill Business Park Whitehill Way Swindon SN5 6PB T +44 (0)1793 89 2667 M +44 (0)7795 354 382 john.norbury@rwe.com
Company Name:	RWE Group of GB companies, including RWE Generation UK plc, RWE Innogy UK Limited and RWE Supply & Trading GmbH.
Do you believe the proposals provide sufficient clarity and transparency to Transmission Users on how Sub-synchronous Resonance, Sub-synchronous Torsional Interaction and related phenomena will be managed where Transmission Licensees are installing new equipment?	Yes subject to the following changes to the Proposed Legal Text given in Annex 2 to the Consultation and also our requested change under the proposed implementation approach: CC.6.1.9 The acceptance criteria, referred to in the legal text, for determining the suitable level of dampening is difficult to quantify and is site specific since affected Users equipment will have differing levels of withstand capability. It is therefore suggested that the User shall have a recognised input in determining what is acceptable or unacceptable. Our proposed change to the draft legal text is as follows: -: "**NGET** shall ensure that **Users' Plant and Apparatus** will not be subject to unacceptable sub-synchronous oscillation's, as determined by the affected **User**, and ~~conditions as specified in~~ that do not comply with the relevant **Licence**

	Standards." CC 6.1.10 It is not clear in the legal text what is meant by "*site specific conditions*". We would expect that these conditions would be in the form of a commitment provided to the affected User for information and not require the affected User to necessarily take action. Our proposed change to the draft legal text is as follows: - "NGET shall ensure where necessary, and in consultation with Transmission Licensees where required, that any relevant site specific conditions applicable at a User's Connection Site, including a description of the sub-synchronous oscillation conditions considered in the application of the relevant Licence Standards to ensure positive damping of sub-synchronous oscillations, are set out in the User's Bilateral Agreement. The affected User's Bilateral Agreement shall contain sufficient information to demonstrate that suitable damping of sub-synchronous oscillations has been achieved."
Have you identified any adverse, perhaps unintended, consequences of the proposals? If so what are they, and how should the proposals be improved?	No
Do you support the proposed implementation approach?	Whilst the proposed approach clarifies National Grid's role in ensuring that Users are not adversely affected, there is not sufficient detail contained in the proposal to ensure any positive damping applied would be sufficient and robust/resilient to network/system changes. The results of the simulation studies to be carried out by the party effecting the change (i.e. RTLs) must be validated with real data to confirm the results are representative. To ensure that a User's synchronous generating plant, being the plant most at risk, is not adversely affected by insufficient damping or damping that is not robust / resilient to network changes beyond the User's control, it will be necessary for the User to fit torsional vibration monitoring equipment to the generator-turbine shaft. This would be the only

	reliable way for the User to ensure that such oscillations are being successfully damped. We believe that the cost of such a monitoring system should be borne be the party affecting the change, namely owners of HVDC converters and series compensation equipment. It is therefore requested that the proposed change is extended to capture this obligation on the party effecting the change.
Do you believe that GC0077 better facilitates the appropriate Grid Code objectives?	Yes for the reasons given in the Consultation Paper. *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) to facilitate 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; and* *(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.*
Please provide any other comments you feel are relevant to the proposed change.	

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Respondent:	Alastair Frew
Company Name:	ScottishPower Generation
Do you believe the proposals provide sufficient clarity and transparency to Transmission Users on how Sub-synchronous Resonance, Sub-synchronous Torsional Interaction and related phenomena will be managed where Transmission Licensees are installing new equipment?	Yes, provided that sections CC.6.1.9 & CC.6.1.10 are Grid Code sections which will be covered by NGET's transmission licence.
Have you identified any adverse, perhaps unintended, consequences of the proposals? If so what are they, and how should the proposals be improved?	No
Do you support the proposed implementation approach?	Yes

Do you believe that GC0077 better facilitates the appropriate Grid Code objectives?	Yes
Please provide any other comments you feel are relevant to the proposed change.	Although this modification improves the situation for users there are still areas around sub-synchronous resonance which still need to be addressed and clarified namely:- Ongoing requirements on HVDC owners; Who meets costs of these requirements; Interparty liabilities in the event of a failure.