

Minutes

Meeting name	GC0075 Hybrid Static Compensators
Meeting number	1
Date of meeting	15 th May 2014
Time	10am – 2 pm
Location	Conference Room E10, National Grid House, Warwick Technology Park, Warwick

Attendees

Name	Initials	Company
Graham Stein	GS	National Grid, Chair
Richard Ierna	RI	National Grid
Robyn Jenkins	RJ	National Grid
Catherine Hiorns	CH	National Grid, Technical Secretary
Antony Johnson	AJ	National Grid
Sridhar Sahukari	SS	DONG Energy
Mick Chowns	MC	RWE
Charles Cresswell	CC	Senvion UK
Razvan Pabat-Stroe	RPS	Scottish Power
Ian Cunningham	IC	Alstom Grid
Isaac Gutierrez	IG	Scottish Power
Clifton Ellis	CE	S&C Electric
Damian Jackman	DJ	SSE Generation
Mick Barlow	MB	S&C Electric
Chinglai Mor	CM	Siemens
Alireza Mousavi	AM	ABB
John Diaz de Leon (T-con)	JDL	American Superconductor Europe
Mike Lee (T-con)	ML	Transmission Investment

Apologies

Name	Initials	Company
Rui Rui	RR	Iberdrola
Fahd Hashiesh	FH	ABB
Dave Walker	DW	Alstom Grid
Lee Holdsworth	LH	RES
Peter Jones	PJ	ABB
Peter Thomas	PT	Nordex
Ahmed Shafiu	AS	Siemens Tx and Dx Ltd
Narend Reddy	NR	American Superconductor Europe

1 Introductions/Apologies for Absence

1. Introduction to the workgroup and the purpose of the workgroup.

2 Grid Code and Workgroup Objectives

2. GS explained the Grid Code Workgroup process and the objectives of the Grid Code to new members of the workgroup.
3. The aim of the workgroup is to produce a report in line with the terms of reference and submit it to the Grid Code Review Panel (GCRP).

4 Introduction to the Grid Code Modification Process

4. GS explained the Grid Code Modification Process. Slides can be found [here](#).
5. GS explained that any revision of the Grid Code must be justified against a Grid Code objective. It was specifically highlighted that changes would need to be assessed for their alignment with the EU codes, specifically the 'Requirements for Generators' (RfG).
6. The time scales have not been fixed by the panel. A standard workgroup has around 4 meetings. GS suggested the workgroup should anticipate submitting a report to the Grid Code Review Panel (GCRP) by December 2014.

4 Introduction to Terms of Reference

7. The workgroup acknowledged that the Terms of Reference are currently in draft form. The terms of reference will be sent back to GCRP for July panel for approval.
8. A discussion began regarding harmonics from STATCOMs / SVCs, as this was noted as an issue but it was agreed this was outside the scope of this work group. The working group agreed that their task was to consider the overall performance of a Hybrid STATCOM / SVC as opposed to looking at power quality issues.
9. Clarification was sought by CC on what a 'secured event' is: this is defined in the Security and Quality of Supply Standards (SQSS).

4 Background and Requirements

10. RI presented the background to the issue National Grid had identified with certain Hybrid STATCOM / SVC designs. Slides can be found [here](#). RI explained National Grid's view that in order to meet system requirements, all Hybrid STATCOMs / SVC's should be able to provide continuous voltage control which would be required to:
 - a. Ensure system voltage is maintained within SQSS limits any voltage dips below 0.85pu last <2.5secs to prevent cascade tripping
 - b. Ensure an initial reactive power response within 1 second as currently defined in the GB Grid Code
 - c. Ensure delivery of available reactive reserves during critical events
 - d. Ensure repeatable response within DAR and operator time scales
 - e. Ensure consistency with RfG
 - f. Ensure a response provided in the event of interactions with similar equipment in adjacent Power Park Modules
 - g. Ensure repeatable response such that contingency and defence studies produce reliable results
11. The two key issues as seen by National Grid are: the ability of Hybrid STATCOMs / SVCs to respond to multiple DAR events within a short space of time; and how Hybrid STATCOMs / SVCs respond during after a fault. National Grid's objectives therefore are:

- a. If required, capacitors or reactors should remain connected during a fault and / or post fault
 - b. Equipment should be capable of meeting the 1 second response time as currently defined in GB Grid Code
 - c. Equipment should be capable of Repeatable, Consistent, Predictable and Continuously Available operations which are quicker than DAR time scales
 - d. Equipment should support the voltage to 0.85% post fault within <2.5 seconds to prevent cascade tripping of generation
 - e. Requirements should be consistent with RfG
12. CM highlighted the need for clarification over what a repeatable event is. CM identified a need to establish under what time scale a repeatable event is required. RI responded by stating that NGET would like to understand what was achievable with the technology currently in planning or being fitted by the various manufacturers.
 13. RI identified a risk of voltage collapse in the extreme as a result of Delayed Auto Reclose (DAR) events combined with delayed response from Hybrid STATCOMs / SVCs.
 14. The workgroup highlighted a concern for the need for clarification around interpretation of the Grid Code, specifically regarding testing of the equipment.
 15. AJ clarified the requirement for a STATCOM / SVC on the system to be able to capture a transient event; (i.e. a voltage drop of more than 10% change) corresponding to a required reactive power output change of 90% response of reactive power within 1 second.
 16. SS asked where the definition on size of step change is within the Grid Code. CC noted this had been interpret as the slope setting on the wind farm. RI confirmed testing from maximum lead to maximum lagging (maximum reactive power input to max power output); MC noted that historically that this was not assumed that this had to be achieved in 1 second. CE stated that a voltage controller could be tuned to achieve this response. The trade off between a stable response and speed was noted.
 17. The workgroup established a general consensus that there was greater clarity required for size of step change, in relation to initial starting position and transient conditions. SS and MB identified receiving differing answers from National Grid staff on the issue and CC stated this added uncertainty and risk to the control strategy. AJ agreed it may help to specifically state the requirements apply from unity power factor and provide consistency between the parts of Code related to testing (i.e. Compliance) and those parts of the Code which specify the requirement (i.e. the Connection Conditions), which are the subject of discussion in the workgroup.
 18. ML noted a need to ensure any changes are also reflected into the STC, section K. It was agreed as an output of the work group the STC Review Group should be informed of any consequential changes. ML noted that the STC Review Group were waiting for the Grid Code working group to review the issue and were keen to see a resolution that would work in the Grid Code and which could equally be applied to the STC
 19. MC and MB both noted they need to understand the challenges National Grid were seeking to address. MB would like a list of external criteria to be identified and National Grid not to stipulate the internal mechanisms to resolve these. AJ confirmed the Grid Code tried to avoid stipulation detailing solutions, but rather sought to define the requirements through a functional requirement.
 20. IG noted the current time response requirements. It was noted that some parties have been unable to comply with these requirements when using Hybrid STATCOMs. The use of fully rated STATCOMs as an alternative is significantly more expensive. The preferred solution would be to use Hybrid STATCOMs / SVCs but external requirements were preventing this. CE noted that this may not be preventable.
 21. AJ agreed that by fully understanding the Transmission System requirements, we will then be able to establish if external requirements are able to facilitate the use of hybrid STATCOMs / SVCs.

22. The EU code RfG (It should be noted that these are presently going through commitology and no final codes are yet available) was highlighted by RI as identifying a bare minimum that Hybrid STATCOMs / SVCs must comply with and added that this could be interpreted such that a Hybrid STATCOM or SVC could be required to provide repeatable performance within the time scales t1 and t2 specified in RfG.
23. MC believes that the RfG solves the issue, previously identified, relating to the size of step. AJ added anything which can be mapped directly from RfG to the GB Grid Code wouldn't be expected to change the requirements of the Grid Code.
24. CE stated that real world conditions, could result in voltages being anywhere on the droop characteristic. If target voltage was above or below nominal, then a power park module will import or export reactive power. Changing the voltage set point affects both reactive power and voltage and the equipment may therefore still operate within the droop characteristic.
25. RI described in detail how DAR applies and the relevant timings that are used in National Grid. For NG typically ≥ 15 seconds from a trip to a circuit being operational again. On re-establishing the circuit, a second timer starts, this period is known as the reclaim time. If a fault occurs during reclaim time, the circuit is tripped again and locked out. However if the fault occurs after the reclaim time, it will not lock out and the process starts again. Reclaim times of 4 seconds are typical for National Grid. Scenarios which cause such events are lightening storms, debris on line, high winds.
26. RI explained DAR with respect to STATCOM / SVC operation. DAR can result in regular STATCOM / SVC switching, the reactive power support needs to be available after each fault. Evidence was presented relating to multiple DAR events.
27. The workgroup discussed whether a wind farm should be expected to help recover such conditions. It was noted by RI and AJ that a conventional generator would be able to provide this support, and that conventional generation was able to exceed their steady state requirement for a short period of time adding further contingency for such situations.
28. DJ highlighted from examples of DAR events the likelihood of an event occurring in less than 15 seconds looks very slim. MB stated the need to clearly define the characteristic required by the Transmission System, as this can potentially be provided by various means such as short term over ratings and it is therefore important to identify external characteristics and not specify the source of the reactive power beyond the point of connection. Furthermore, there is a need to identify a sensible test to ensure the voltage control system works correctly.
29. AJ confirmed the need to identify the test criteria and that National Grid is only interested in specifying the requirements based on the minimum needs of the Transmission System.
30. The work group considered how Hybrid STATCOMs / SVCs recover between events to understand impact of multiple DAR events. Functional Requirements need to be very clear and should not assume a specific operation of Hybrid STATCOM / SVC. If a Hybrid STATCOM / SVC cannot achieve these functional requirements, then we will need to consider the additional cost of implementing a solution against system impact. DJ highlighted a need to ascertain that multiple DARs would not result in wind farm trip, which would render the investment in an alternative device as redundant.
31. The workgroup also discussed applying different requirements for generators in different locations, depending on the system requirements. However, RI and AJ stated multiple DAR operation has the same risk across the country as a common cause of multiple DAR operation is stormy weather. Further, National Grid does not want to have different locational connection terms that could potentially favour one party over another. SS was also not in favour of site specific requirements.
32. MC highlighted an example of an offshore wind farm at the end of the double circuit where the agreement included intertripping requirements – in the event of a double circuit fault the wind farm also tripped. AJ agreed in such an instance the concerns around Hybrid STATCOMs are negated. However, it was noted that this situation will not occur in every offshore wind farm development.

33. MC made reference to small signal stability and the need for simulation studies. It was suggested small signal stability should be investigated first and then the issue of full transient events.
34. RI discussed the concerns relating to MSC shut down during faults i.e. during faults some designs switch out capacitors. RI highlighted a concern that during post fault conditions, switching out Hybrid STATCOMs would result in there being less reactive power available on the system, therefore increasing the risk of voltage collapse. MC highlighted that this had been an issue in some projects, as there were concerns relating to overvoltage however these were resolved.
35. The workgroup highlighted an area at risk of misinterpretation within the Grid Code. The phrase maximum output appears reasonable until further consideration was given with respect to the transient rating.
36. MB explained how simulations demonstrated the use of Hybrid STATCOMs can be compliant with the Grid Code from a dynamic perspective. MB stated simulations demonstrating a correlation between reduced STATCOM output and no output are not applicable to all manufacturers. Furthermore it was argued that Q injection from a new connection should not be used to fix an existing problem. In conclusion simulation comparisons of a Hybrid STATCOM and a STATCOM show a similar response. In addition the studies showed that minimal and achievable capacitor switching was required to achieve the desired result. Therefore MB argued switching is irrelevant to the issue and there is a need to identify the requirement and then investigate if there are any issues in achieving this.
37. RI stated that new connections would not be expected to fix an existing problem and that a more plausible scenario would consist of an existing SQSS compliant power oscillation prior to the new connection but not after. In addition RI agreed that short term rating, use of Power Oscillation Damping (POD), capability within the asynchronous generators or any other means available would be an acceptable alternative and under such circumstances this would therefore not prohibit the use of a Hybrid STATCOM / SVC.
38. AJ advised there was a need to understand what different performance Hybrid STATCOMs can achieve and the price differentials to achieve this. It was appreciated that this is sensitive information, so suggested this be provided as a percentage increase to give an idea of additional cost and capability.
39. The workgroup concluded that the main concern highlighted by RI, AJ and MB is that the Hybrid STATCOM's ability to achieve repeatable response within DAR and operator time scales is unclear. RI and AJ still highlighted concerns over response during post-fault conditions.
40. MB again noted that the word switching should not be used to define the performance requirement as it presumes the internal design of the device. It was noted there was a need to clearly quantify statements to avoid issues around different interpretation of the Grid Code.
41. The workgroup recognised the need to understand the limitations of the technology. RI stated National Grid's desire to facilitate the use of Hybrid STATCOMs and the cost saving these provide. However the workgroup also supported the use of further data to better understand the system need.
42. **ACTION – RI and AJ to compile more information to help quantify the system need in the previous described circumstances, particularly in relation to DAR times for all TSO's (Transmission System Owners) and DNO's (Distribution Network Owners).**
43. The workgroup highlighted a concern to ensure that the code does not alter to become more onerous than Europe. This would make GB generation less competitive than Europe. IG noted that currently some areas of Europe had more onerous regulations on the use of Hybrid STATCOMs than GB.
44. **ACTION – RI and AJ to look into incident reporting and data logs for more detail regarding DAR with a view to better understand the operational challenges and clarifying the system requirements.**

45. The work group recognised that to fully understand the technical requirements and the potential of Hybrid STATCOMs to meet the system need there is a need to consider what is currently available. Furthermore, there is a need to make the requirements for the technology clear and reflective in the Grid Code.
46. **ACTION – RI and AJ to work with MB produce a survey for manufacturers and developers to understand the limitations and cost implications associated with improvement of the various alternative technologies.**
47. **ACTION – Manufacturers to consider the information that they are able to provide to ensure survey can be answered in a useful manner.**
48. **ACTION – RI and AJ to review National Grid’s internal technical specification and establish whether there are useful features to use as an initial base to start to draft technical requirements.**

4 AOB

49. None discussed

4 Date and Time of Next Meetings

50. GS - Date of the next meeting is to be determined once it has been established how long needed to complete actions. Anticipate that this will be around end of July. Send out doodle pole to establish availability and then need to confirm date with plenty of notice.
51. **ACTION: CH arrange doodle pole to establish availability**