

Minutes

Meeting name	GC0075 Hybrid Static Compensators
Meeting number	4
Date of meeting	26/01/15
Time	10:00-15:00 National Grid, Warwick
Location	Tele conference - 0808 238 9819 Participant Code - 81833258#

Attendees

Name	Initials	Company
Antony Johnson	AJ	National Grid, Chair
Richard Ierna	RI	National Grid
Franklin Rodrick	FR	National Grid, Technical Secretary
Charles Cresswell	CC	Senvion UK
Shafiu Ahmed	SA	Siemens
Fahd Hashiesh	FH	ABB
Isaac Gutierrez	IG	Scottish Power
John Diaz de Leon	JDL	American Superconductor Europe
Razvan Pabat-Stroe	RPS	Scottish Power
Laurent Poutrain	LP	VIZIMAX Inc.
Sigrid Bolik	SB	Senvion UK
Mick Barlow	MB	S&C Electric
Damian Jackman	DJ	SSE Generation
Lee Holdsworth	LH	RES
Peter Thomas	PT	Nordex
Sridhar Sahukari	SS	DONG Energy
Niall Duncan	ND	Senvion UK
Amir Dahresobh	AD	Nordex

Apologies

Name	Initials	Company
Graham Stein	GS	National Grid
Steve Mortimer	SM	S&C Electric
Mick Chowns	MC	RWE
Mike Lee	ML	Transmission Investment
Peter Jones	PJ	ABB
Alireza Mousavi	AM	ABB
Narend Reddy	NR	American Superconductor Europe
Clifton Ellis	CE	S&C Electric
Ian Cunningham	IC	Alstom Grid
Dave Walker	DW	Alstom Grid
Rui Rui	RR	Iberdrola
Philippe Maibach	PM	ABB
Simon Vogelsanger	SV	ABB

1 Introductions/Apologies for Absence

1. AJ started the meeting with a brief introduction of the aim of the workgroup. AJ highlighted that the workgroup report will be submitted to the GCRP in May 2015. The working group members then introduced themselves.

2 Minutes from previous meeting

2. The previous workgroup minutes were discussed and there were no further comments or amendments. The workgroup confirmed that the previous minutes were a true and accurate reflection of the previous meeting.
3. The actions from the previous meeting were reviewed. All the actions were addressed in the Hybrid STATCOM / SVC presentation.

3 Hybrid Statcom/SVC – Presentation

4. RI delivered a presentation providing a progress update on the National Grid actions from the previous meeting.
5. RI highlighted the key objectives of the workgroup which is to prevent post fault voltage collapse and over voltage following repeated events on the Transmission System. RI added that repeated response performance during fault events is important. He went on to advise that on one hand there was a requirement to satisfy the minimum needs of the Transmission System and on the other, ensure the requirement was achievable and economically justified. RI said that the proposed solution should not be site specific to ensure transparency to all Generators.
6. SS questioned the supply of active current performance requirements as it's not currently mentioned in the grid code. RI advised that there is some draft legal text in the slides that addresses this issue.
7. RI highlighted that there is a universal requirement for the reactive response for different types of Power Park Modules to fulfil National Grid requirements even though they may be based on different generation technologies.
8. RI briefly explained the different types of events that can occur on the Transmission System. RI highlighted that the legal text did not cater for angular instability and the interaction between controllers, noting these issues could be a worry but the proposed compromise meant manufacturers had a wider variety of switch solutions. However he did advise that the overall work did statistically cover most events recorded on the Transmission System over the last few years.
9. RI explained the type of events that the workgroup should take into consideration. This shows the typical number of events in a year. This is to reassure manufacturers that the type of events the workgroup is looking at does not occur frequently but is only likely a couple of days in a year. RI clarified that National Grid would not anticipate much wear and tear on the equipment. RI explained the concern that workgroup members have highlighted in previous meetings regarding the wear and tear on the switches due to repeatability.
10. RI gave an explanation of the Scottish Storm data analysis. RI explained the time taken by the STATCOM to respond after an event. The purpose of the slide was to determine the proportion of events that can be covered by setting the repeat response time to 10, 15 and 20 seconds etc.
11. RI highlighted that if the repeat time was set to 20 seconds then 92% of events would be covered. He added that if the switch time is reduced to 10 seconds then 96% of events would be covered. It was noted that the suggested repeat time should be set at 15 seconds to cover the

wider variety of switching devices. RI explained that the blue line on the graph was the average time taken by all events.

12. It was noted that the main constraint on repeatability is the Spring Recharge time. RI highlighted that the maximum Spring Recharge time for different switching technologies is currently in the order of 15 seconds.
13. SA questioned what the Y-axis represents on slide 8 and the time taken to perform switching? RI explained that the graph is based on a 15 second gap between two events. He added that the Y-axis represents the proportion of the events that the STATCOM would be able to respond to. RI noted that some events occur within 4 seconds and would fall outside the switching time of 15 seconds.
14. RI explained the different types of storm events and the time elapsed between each event. CC questioned if the events were on the same line or on different parts of the Transmission System. AJ explained that the faults were not on the same line but would have been on different parts of the system
15. RI gave a summary of the number of events that occurred, the duration of these events and the time between each event. AJ added the table showed the frequency of events over a period of time and also the clusters of events that can occur.
16. MB questioned whether the data was independent of the location? MB questioned whether two trips can be in different parts of the country. RI answered that this is possible. CC queried what a trip event is considered as?
17. SA queried what a cluster of events is? RI explained the criteria of the cluster of events is where you could have say 5 events which occurred less than a minute apart and then a similar sequence occurred sometime later in the day.
18. LH questioned the repetitive events and what the wind speed was likely to be at the time of the events and whether Wind Turbines would be switched off? RI answered that in this case the wind speed would have been high as these are winter storms but the solution should be fit for all types of generation and not just wind as other types could operate under such conditions.
19. MB questioned whether the applicability of the repeated reactive response was for synchronous or for asynchronous plants. AJ explained that synchronous generation plants should not have any such issues and the scope of the working group was specifically to cover performance of Reactive Compensation equipment installed within Power Park Modules.
20. RI gave a brief overview of the multiple circuit trips that have occurred on the transmission system over the last few years and that some of them resulted in DAR restoration. RI highlighted that this data has been presented in previous meetings but for the purpose of this meeting a summary of the winter storms and the lightning events has been done separately.
21. RI gave an explanation on lightning strikes which occurred between 2001 and 2006. RI added that even though the data is a few years old it was not expected that the frequency of lightning events had changed significantly. RI highlighted that the most likely time of the day for a lightning strike is the afternoon and the Summer period is the worst time of the year for them to occur.
22. SB questioned whether are you looking at contingencies caused by switching due to lightning strikes or lightning strikes that can be relevant to any Hybrid devices?
23. RI highlighted that the lightning strike can result in multiple DAR events. AJ explained lightning can strike at different parts of the network and that can result in a number of events. He added that all the data was taken together to determine how likely faults on the transmission network would occur.
24. SA queried whether the graph represented any fault data or just lightning events and whether they caused any events on the system. AJ / RI explained that the graphs only represented lightning and was independent of any other events on the system.

25. RI explained the graphs on the areas in the country that are badly affected due to lightning strikes. RI highlighted that this data showed different parts of the country are badly hit by lightning strikes at different times, it would be difficult to limit the effect to specific Geographic areas.
26. RI showed examples of lightning strikes that occurred due to storms in 2001 but added that these may not have necessarily hit the transmission system, they were simply demonstrated geographic intensity for a particular within a specific area of the country.
27. RI gave an explanation of the Future Energy Scenario data. It was noted that between 2020 and 2035 there would be a considerable amount of renewable generation that would be connecting to the system. He added that if the issue is not resolved then it could become a major problem. RI highlighted that renewables could comprise of 40GW of the total generation in this period and added that during this period, renewable generation would therefore be responsible for the provision of a significant volume of reactive response.
28. AJ added that the new generation of nuclear plants are larger. He added that there could be possible scenario with a few synchronous generators with the remainder being made up of renewable generation. This would not be the same as the traditional arrangements where there was a high volume of synchronous generation dispersed throughout the system. . RI added that NG would have contingency for 1800MW but in some cases this only represents one generator. Furthermore operating the system with the largest loss set at 1800MW rather than 1320MW would result in more operational challenges.
29. MB queried whether the Future Energy Scenario analysis includes solar and it was noted that it is unclear whether solar is included or not. Subsequent discussions at National Grid have confirmed solar is included in the FES and netted off demand.
30. RI explained the slide and highlighted that this data was split between summer and winter events.
31. RI highlighted that National Grid have not spoken to the Scottish TO's regarding the revised legal text and that he had only circulated a previous version of the text.. RI advised the group to consider the revised wording post meeting.
32. RI highlighted that the Control Room would have to be notified about any restrictions in reactive reserve following a sequence of events and would also require a notification of when full reactive reserve was available. RI highlighted that manufacturers were concerned that the switches would be required to operate endlessly. RI said initially it was proposed that there should be an alarm which sounded after a specified number of operations, after which the generator could request that the switches could be locked open or closed. However following consultations with one of the manufacturers, they raised a concern that they have no control over the equipment once it is installed and therefore believed it necessary to define a limit on switching operations.
33. After discussions with the Control Room, it was agreed a limit could be placed on switching operations but it would be the Generators responsibility to inform the Control Room of their reduced or available reactive capability.
34. AJ explained that the Generator would be required to inform the National Grid control room of the reduced reactive capability, whether there is a lockout and when full reactive capability is restored.
35. SS questioned if there was a move towards deloading generation. AJ highlighted that this was not a requirement but we do need knowledge of reduced reactive capability. He went on to say if there was a deficit in reactive power then this would need to be obtained from elsewhere.
36. CC questioned the implications where there is a reduction in reactive capability. RI explained that if the plant failed, then it's a different scenario but the requirement as currently proposed makes it explicit that after 25 events the plant is permitted to lockout for up to 6 hours. He also advised that once capability has been restored the Generator would need to notify National Grid.
37. SA queried if 25 events in the day included natural variation on the system along with actual events should the developer still report any reduced reactive capability to the Control Room?

38. RI explained that if the decision is made to go ahead with the proposed text, then the wording will need to be reviewed regularly. SA highlighted that the type of events included in the 25 events per day should be captured in the legal text. AJ highlighted that small voltage deviations or perturbations which were not caused by a fault should not be included in the 25 events in the day.
39. RI discussed a control interaction scenario where the equipment, on one occasion, switches about 100 times in one day. This scenario would probably not have any impact on the equipment but would give the control room time to react and this was the original thinking behind the alarm and request for a lockout requirement which has now been relaxed.
40. MB highlighted that there should be some defined criteria so that the developer can design the equipment to switch every 15 seconds in order to be compliant.
41. CC said that the 25 events per day should only apply for significant changes on the Supergrid System in order to satisfy the reactive response requirement and not any minor voltage depressions. CC added that there is a concern how many times would an event with a 4 – 5% voltage drop would occur on the Supergrid and what the possible causes are and the need to put this in context.
42. RI highlighted that the Control room are motivated to push the devices to unity power factor and maintain reactive reserves such that they can respond to an event. AJ added that it is rare for a plant to be operated in its full lead or lag position pre fault.
43. SS said there is no clarity between continuous voltage control and transient voltage control. He added that clarification in this area would be useful as it would clearly identify the repeatability criteria.
44. RI highlighted the new wording which says the reactive element shouldn't switch in first 140 milliseconds. RI added that the equipment should ride through in the first 140 milliseconds and then in the post fault stage the decision could be made to switch. RI said that there could be danger that if the capacitor is switched out there may be no reactive support post fault.
45. RI discussed the survey results and it was noted that only one response was received. RI highlighted that there are other manufacturers who possess the capability or are developing equipment to meet the proposed requirements. He advised that he would contact manufacturers following the meeting and get a written confirmation of their capabilities. He also added that his aim was to publish an anonymous summary of the results pending agreement of the manufacturers.
46. CC questioned if National Grid have asked the manufacturers about the cost of the new equipment. He added that if the costs rise significantly then the economics need to be questioned. .

RI highlighted that a question that was raised regarding Doubly Fed Induction Generators (DFIG's). RI said he had spoken to DFIG manufacturers who had advised that the proposals can be met with current designs and would not therefore increase converter size and cost in the wind turbine.
47. RI discussed the draft legal text and reiterated the latest draft had not been discussed with the Scottish TOs and they would have to go back and comment on it.
48. RI highlighted that there were three parts of the Grid Code that will be affected. He discussed the proposed legal text and said that the plant should be able to operate from 0.95 power factor leading to 0.95 power factor lagging within 15 seconds intervals.
49. RI described the second requirement which would require full repeatable reactive response after each event where each event could be 15 seconds apart with a maximum of up to 25 events in a day. After 25 events, the Generator can declare a reduced reactive capability to NGET. He also stated that after 6 hours of the final event, the plant should automatically restore reactive capability and the Generator should notify NGET that the reactive capability had been fully restored.

50. SA questioned the 6 hour period following 25 events. He asked whether this period is for the equipment to cool off as it had technically not failed. He questioned whether this is because the plant has fulfilled the obligation to provide support for the 25 events.
51. RI explained it was due to the design requirement and the need to provide some form of quantification as to the number of switching operations the equipment would need to be exposed to. He added that the software would be configured in such a way that after 25 events the reactive capability is reduced and after 6 hours it's fully restored. RI advised that the time limit of 6 hours was considered a reasonable time frame.
52. RI noted that if the switch has failed after a certain number of events then the Generator should contact the Control room and inform them that they will be out of service for a specified period of time. RI said after 25 switching events in one day, the system will reduce its reactive capability automatically and the Generator will then need to notify the control room.
53. The Workgroup asked if 25 events could be within 10 minutes and whether they would have to design the system in accordingly.
54. SS questioned whether National Grid has a justification for 6 hours and why it was not 12 hours. He added that once the equipment is locked out, the intention is to bring it back to service automatically after 6 hours but advised that in the event of a problem with the Generators Plant which affects its availability or return to service, National Grid Control should be notified immediately.
55. MB said the text should be changed such that if after 6 hours the reactive capability is not restored, then National Grid should be informed. RI explained that the text requires the National Grid Control Room to be informed of the reduced reactive capability after 25 events and again when the reactive capability has been fully restored which should be within 6 hours of the last event.
56. SB said it would be useful to have something in the legal text that considers the slope setting. SA asked why the slope is important? He added that the proposed requirements should be independent of the slope, there is a limit of 25 events in 24 hours, so why should the slope be included.
57. SS highlighted that this requirement is only for transient voltage control and there seems to be no link between slope and the requirement. AJ added that as part of the workgroup the requirement is designed only to cover transient events.
58. SA advised that if you are on a sensitive slope, small variations in network voltage is more likely to generate 25 events quickly.
59. MB advised that based on the capability of the wind farm the STATCOM may only provide a small percentage of the overall reactive capability.
60. RI highlighted that the next section affected is Fault Ride Through. RI said the only amendment is in reference to reactive compensation equipment. MB advised that he has issues separating the Power Park Module and hybrid equipment. He added that the requirement should only apply to Power Park Modules. SS added that there is no need to separate this out. RI was in agreement that it can be changed to Power Park Modules.
61. RI advised that the CC.6.3.15.1(a) of Grid Code fault ride through requirements effectively state that the plant should ride through the first 140 milliseconds.
62. SA said there are technical reasons in hybrid statcoms why the capacitor banks are switched off. He added that it would be unclear what the voltage profile would be post event. RI asked how long it would typically take to switch the capacitor banks back on once they had been switched off.
63. CC enquired as to whether the current capacitors on the Transmission System remain switched in and are there any problems with this. RI said they remain switched in and there haven't been any issues.

64. SA advised that the current requirement was for capacitor banks to remain connected unless the voltage falls below a certain level.
65. SA said National Grid have previously advised that Statcom's can block if the voltage falls below a predefined level.
66. MB asked if the above criteria is removed (i.e. the requirement for STATCOM's to be switched out if the voltage falls below a certain level) and the plant is designed for the same purpose Would that be a problem? AJ added that there would be too many switching operations in one event but MB said in response what if the plants can provide the reactive power to meet the requirement?
67. MB said the criteria should not be unambiguous and then it's upon the manufacturer to design the equipment. It is then clear that if the criteria is not met then they are non-compliant.
68. MB said that under the Power Park controller arrangements the majority of the reactive power will come from the turbines and this raised a question in terms of the compliance requirements of the STATCOM alone.
69. RI highlighted that for Fault Ride Through there are two Grid Code requirements which are defined under CC.6.3.15.1(a) and (b) and CC.6.3.15.2 and either of them can be satisfied. He added that they are very similar and so only one has been put on the slides. The draft text includes requirements which states that any switched reactive component that was connected prior to the fault should remain connected.
70. SA stated the instruction given for switching the capacitor bank out is based on the voltage magnitude being specified for the design.
71. AJ explained that the proposed changes highlight that the Generator will need to notify NGET about its reduced reactive capability after 25 events have taken place. He added that after 6 hours of the last event, the generator should notify NGET that full reactive capability has been restored.
72. MB questioned the 6 hours requirement in the draft text. AJ highlighted that the text could be changed adding that the Generator should notify NGET as soon as there is any reduced reactive capability and once it's restored, they should notify NGET again. RI added 6 hours was chosen arbitrarily on the basis that the equipment hadn't failed but was taking protective action and should auto restore capability but notification of both events is still required. MB said that this could be misinterpreted.
73. CC asked whether they have to notify NGET about any other reduced capability due to failure of equipment or is it just that the Generator notifies NGET after 25 events. RI added that the Generator would have to inform NGET in any circumstance which changes the performance of their Plant and Apparatus.
74. In response MB questioned whether the Generator would be penalised. In respect of reactive capability, AJ highlighted that the plant would not be paid for the provision of reactive power where it was previously being supplied.
75. SA queried whether the payment is at the Offshore Grid Entry Point or at the Interface Point, for an Offshore Wind Farm. The group had a discussion about payment for MVAr and it was identified that the Generator gets paid for the provision of reactive power only at the connection point. AJ explained that for synchronous generators, NGET give instructions to Generators for the provision of reactive power and the Generator gets paid for the provision of this service. He added that in case of Asynchronous Generation, the Generator is given a set point value and slope with a payment being made for the provision of reactive power each time the Generator imports or exports reactive power from the system (which would vary depending upon how the system voltage varied with respect to the set point). AJ advised that there is no payment for reactive power at the Interface Point unless some of that contribution is derived from the Offshore Wind Farm at the Offshore Grid Entry Point in which case the offshore wind farm will be compensated directly.

76. AJ discussed the slide on next steps. He added that the group has had some good debate and National Grid have taken some actions to review the text and circulate it to the work group.
77. AJ / RI took an action to prepare the draft working group report which would summarise the issues discussed during the workgroup meetings and suggest legal text changes. The report would be circulated to the group for comments and also to ensure that the text changes are robust. Once this has been completed the intention is to submit the report to the GCRP in May 2015 after which an industry consultation would be take place. A report to the Authority (Ofgem) would then be submitted to for determination.

Action: AJ/RI to prepare draft working group report and circulate to the group.

78. AJ discussed an additional slide which highlights the amendments that have been made since the last proposal was presented to the group.
79. SS highlighted that STATCOM manufacturing takes about 18 to 24 months and the date for implementation (currently proposed for April 2016) would not be achievable if this was approved by Ofgem in September 2015. AJ added that keeping RfG and lead time for manufacturing in mind the achievable implementation date could be April 2018 but it still requires discussion.
80. MB raised a question about compliance. RI stated that multiple step change tests would not be completed in the live environment and would need to assessed by other means.

Action: RI to speak to compliance team about testing.

81. CC made a point about testing the STATCOM with a wind turbine /farm. He added that the type testing can be very expensive. SA also noted that this would be even more complex for an Offshore wind farm.

4 Discussion

82. National Grid have taken actions to work on the legal text and the draft report. The intention is to circulate this to the workgroup and then the GCRP in May 2015 so another meeting would possibly be required in late March / April. RI said he would contact workgroup members and ask for their views.
83. SA questioned the clause regarding “continuous operation” and asked if it will be linked to the new clause. AJ added that if the new requirements are met then the continuity clause of the Grid Code will be met. SA highlighted that if CC.A.2.7 is met it would fulfil the criteria.
84. CC queried if the report will need to detail the likely costs as opposed to making no change. AJ advised that indicative costs would be included within the report. RI said there haven’t been any official responses to the questionnaire but once the responses are received it will show the cost implications. RI highlighted that there is a risk for not doing anything as it can impact the security of the system.
85. MB questioned whether it was worth considering alternative solutions e.g. rather than install reactive compensation within the Power Park Module, would it not be more appropriate to install reactive compensation equipment on the transmission or Distribution System. . AJ said that this issue would be addressed in the working group report.

Action: Determine cost implications for repeatability.

Action: RI to determine time and date of next meeting

86. MB questioned if these changes are applied retrospectively to old generators or only new generators. AJ answered that this requirement is only for new Generators.

87. CC said that after 25 events the STATCOM would lockout as per the manufacturing design but it should be designed to switch continuously. SA added defining the events can be beneficial while designing the equipment to state either these are associated with daily variations on the voltage or strictly associated events outside +/-5% voltage or combinations of both.

5 Next Steps

NA

6 AOB

NA