Grid Code Review Panel – Development Issue
Continuous Voltage Control - hybrid system
PP 11/21
A Panel Paper by Guy Nicholson
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Summary

At the GCRP in May 2010 a Panel Member and Alternate raised an issue brought to them by several Users regarding NGET's interpretation of the Grid Code in relation to "continuous" voltage control and the design of switched capacitors and reactors in providing that capability.

In November 2010 the Panel has agreed that NGET should bring forward a modification to the Grid Code to ensure clarity of requirements in the Grid Code. The GCRP is expecting a proposal from NGET at a future GCRP meeting.

In the meantime the Panel must decide how the current Code should be interpreted for current projects as there are differing views of Users and NGET.

The paper gives the history of the issue and proposes a way forward.

Users Impacted

Users impacted are those generators with hybrid voltage and reactive power control schemes which involve statcom and switched shunt capacitors or reactors, as well as future generators wishing to employ such equipment to meet the Grid Code requirements.

High

Those Users who developed plant on the understanding that it was Grid Code compliant and:

i) Have had to retrofit equipment at significant cost; or
ii) Have been refused a FON by National Grid or had a FON delayed and this impacted on finance, construction contracts; or
iii) Are still in discussion with National Grid over compliance; or
iv) Are impacted by a derogation process.

Medium

Those Users who are developing and commissioning projects with this kind of equipment and who face uncertainty on National Grid's interpretation of the Grid Code and the forthcoming proposed Grid Code Change.

Low

Unknown

Future Users who will have to design and specify to the new proposed Grid Code at an extra cost where the extra cost depends on details of new requirements.

Description & Background

Technical Description

Grid Code Connection Conditions (CC) 6.3.6 requires that all relevant generators should be capable of contributing to voltage control by continuous changes of reactive power. The required reactive capability is described in CC6.3.2 whilst CC6.3.8 and associated CC Appendices detail the performance requirements.

A common “hybrid” voltage control system uses a statcom together with one or more mechanically switched shunt capacitors and/or reactors to provide the Power Park Module reactive capability and voltage control. The statcom is capable of providing rapid changes to reactive power within limits and may use a short term overload capability, whilst the shunt capacitor / reactors provide additional stepped reactive power to increase the overall operating range. With correct design of the rating of the Statcom and design of the switched components such systems have in the past been considered to comply with the Grid Code.

However, National Grid has noted that in relation to the switching of the shunt devices:

> (i) there is a time to charge the operating mechanism of the circuit breaker.
> (ii) after switching a shunt capacitor out of service there may be a delay while the capacitor is discharged before the plant can be switched into service again.

This means that the shunt device is potentially “unavailable” (for a period that is typically 1-20 seconds but may be as long as 10 minutes) if it were to be called upon twice or more in a short time. However, there are no reported instances where such equipment has been called upon to operate within such an “unavailability” period as the shunt devices are switched typically about twice per day.

However, assuming that a significant number and size of installations of this kind will be constructed in the future, and in order to manage both secured events and the risk of cascade failure for more severe events, it is agreed that the requirement should be more explicitly defined in the Grid Code.

At this stage NGET have not tabled proposals for a Grid Code change to clarify their expectations. The speed of initial re-switching of the shunt capacitors and reactors can be increased at relatively low cost, provided this is done at the design and specification stage. Retrofitting equipment imposes significant costs and delays, and in some cases may be practically impossible due to space constraints. However, reports from Users indicate that recent interpretations of the requirements by NGET are imposing significant costs even for new installations due to an indefinite number of re-switching events being specified.

The Role of the Grid Code Review Panel.

The Grid Code states in GC.4.2 "The Panel shall: (d) issue guidance in relation to the Grid Code and its implementation, performance and interpretation when asked to do so by any User;"

The view of the Panel was first sought in May 2010 and the Panel has not yet agreed upon or provided a view.

May 2010 Panel

The issue was first raised under AOB at the Grid Code May Panel as a number of Users had contracted Guy Nicholson and Sigrid Bolik relating to the issue.

1411. GN highlighted an issue surrounding MSC forming part of voltage control system at a windfarm. National Grid has identified an issue with PPM voltage control systems that as a result of delays in the switching times with the static devices mean the control system as a whole is not continuous. GN was of the opinion National Grid have changed the code and are retrospectively going back to compliant PPMs and saying they were non-compliant. JG stated GN this is not the case the Grid Code has always been the same however during the compliance process of some earlier PPMs this issue was not identified. This issue is being dealt with on all generators going through the compliance process currently and National Grid have written out to already connected PPMs to identify if they are non-compliant. JG and GN agreed to convene a meeting to discus the matter for all users as a generic meeting.

Action: National Grid (JG) and GN [1]

The Users concerned continued to hold bilateral meetings with NGET to resolve issues on a bilateral basis and no generic meeting was convened.

September 2010 Panel

NGET submitted a paper to the September panel meeting. "GCRP pp10/24 Voltage Control and Fault Ride Through". Key relevant extracts are:

Hence, the National Grid approach will be:

- Sites with completion date prior to 1 January 2013 and have a performance such that switch recharge time (close-open-close) less than 15 seconds and capacitor discharge time less than 2 seconds will be accepted.
- Sites with completion date prior to 1 January 2013 and have longer unavailability will be asked to seek a derogation.
- Sites with a completion date after 1 January 2013 will be required to have no unavailability of reactive capability.

The Grid Code Review Panel and STC Panel are asked to:

i) note the interpretation of the requirements for reactive power change and reactive current generation.

ii) Consider if any changes are required to either the grid code or/and the STC [2]

Note that the Panel was not asked for its view but was requested to note NGET's view. The Panel's views and discussion was minuted under Item 10 in September meeting minutes 1434 to 1438 including the following:

"Some panel members did not agree with National Grid's current interpretation of the Grid Code."[3]

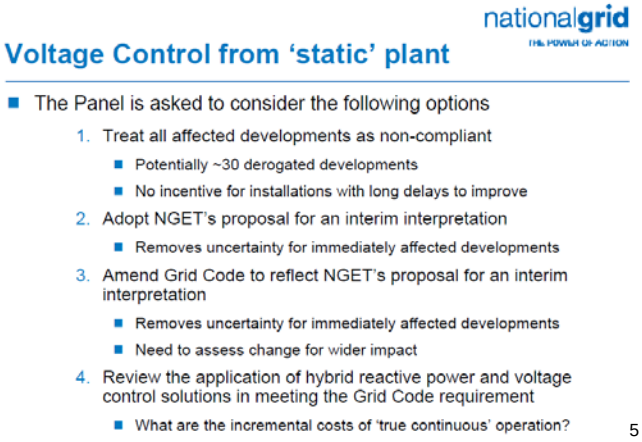
[1] Extract from minutes of May 2010 GCRP
[2] Extract from GCRP pp10/24
[3] Extract from minutes of September 2010 GCRP

"NGET was asked to bring forward evidence of the need to adjust the interpretation along with an impact assessment."[4]

November 2010 Panel

NGET made a presentation at November Panel Meeting which was not provided in advance of the meeting and did not contain any evidence or impact assessment.

The following were offered as options to the Panel.



nationalgrid
THE POWER OF ACTION

Voltage Control from 'static' plant

- The Panel is asked to consider the following options
  1. Treat all affected developments as non-compliant
     - Potentially ~30 derogated developments
     - No incentive for installations with long delays to improve
  2. Adopt NGET's proposal for an interim interpretation
     - Removes uncertainty for immediately affected developments
  3. Amend Grid Code to reflect NGET's proposal for an interim interpretation
     - Removes uncertainty for immediately affected developments
     - Need to assess change for wider impact
  4. Review the application of hybrid reactive power and voltage control solutions in meeting the Grid Code requirement
     - What are the incremental costs of 'true continuous' operation?

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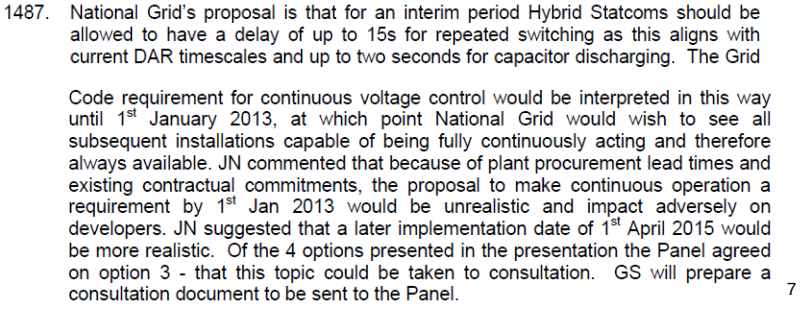
The Panel Agreed on Option 3 which was minuted as follows:

"Of the 4 options presented in the presentation the Panel agreed on option 3 - that this topic could be taken to consultation. GS will prepare a consultation document to be sent to the Panel."[6]

Panel Member Guy Nicholson (GN) understood that Option 3 did not require Users to apply for any derogation, or require any changes to previously used designs, until a Grid Code change to specify these requirements was brought forward consulted on and changed under the normal Grid Code processes.

However the minutes of the meeting stated



1487. National Grid's proposal is that for an interim period Hybrid Statcoms should be allowed to have a delay of up to 15s for repeated switching as this aligns with current DAR timescales and up to two seconds for capacitor discharging. The Grid

Code requirement for continuous voltage control would be interpreted in this way until 1st January 2013, at which point National Grid would wish to see all subsequent installations capable of being fully continuously acting and therefore always available. JN commented that because of plant procurement lead times and existing contractual commitments, the proposal to make continuous operation a requirement by 1st Jan 2013 would be unrealistic and impact adversely on developers. JN suggested that a later implementation date of 1st April 2015 would be more realistic. Of the 4 options presented in the presentation the Panel agreed on option 3 - that this topic could be taken to consultation. GS will prepare a consultation document to be sent to the Panel.

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[4] Extract from minutes of September 2010 GCRP
[5] Extract from presentation titled "Voltage Control Requirements from Static Plant" – the paper has no reference number.
[6] Extract from minutes of November 2010 GCRP
[7] Extract from Draft Minutes of November 2010 GCRP with member comments ref pp11/10

The minutes did not align with Panel Member GN's understanding of the options presented and a change or footnotes to the minutes to reflect GN's position was agreed at the February GCRP.

February 2011 Panel

At the time of the GCRP meeting on 17th February 2011, NGET had not brought forward a change proposal to the Grid Code and clarified whether such a change would be retrospective or only applicable to future projects beyond a specified date.

The issue was discussed and it was agreed to resolve the issue of interim interpretation of the Grid Code with an extraordinary meeting if necessary.

Proposed Solution/Next Steps

At the November 2010 meeting the Panel agreed that NGET should bring forward a change to the Grid Code to clarify the meaning of "continuous" in relation to voltage control and switched capacitors/ reactors.

The Panel must decide how projects should be dealt with in the meantime as it is clear from discussions so far that NGET and Panel members involved have not yet agreed.

Impact & Assessment

Impact on the National Electricity Transmission System (NETS)

Anticipated changes to the Grid Code are not expected to have any adverse impact on NETS.

No adverse impact on the NETS from legacy equipment has been quantified.

Impact on Greenhouse Gas Emissions

The current situation is having and will continue to have an adverse impact on Greenhouse Gas Emissions as the uncertainly and confusion can only have an adverse impact on investment and development of renewable projects in GB.

There is a shortage of investment capital and many other opportunities for international finance if the GB market is seen as risky.

Impact on core industry documents

No

Impact on other industry documents

No

Will the proposed changes to the Grid Code better facilitate any of the Grid Code Objectives:

(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) ; and

NGET has delayed issuing FONs where it has determined that hybrid designs are not classed as “continuous” which has an adverse impact on competition as it creates a barrier to market entry, and financing challenges (see above impact of Greenhouse Gas Emissions). In NGET’s view, if non-compliances are not managed, (and the FONs are an integral tool in the compliance process) then there is a risk sterilising parts of the transmission network to new connections.

(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

Supporting Documentation

- NGET paper to Grid Code Review Panel September 2010
- NGET presentation to Grid Code Review Panel November 2010
- Minutes of GCRP meetings May, September, November 2010.

The relevant extracts have been copied into this paper, the full documents can be found on National Grid web site.

Recommendation

The recommendations are in two sections, (A) specific to this issue and (B) generic to deal with different interpretations of the Code.

A. Provide interpretation and progress Code change process as follow:

1. Ensure that NGET bring forward a Grid Code change proposal to remove the uncertainly of interpretation of “continuous” regarding voltage control and especially in relation to capacitor switching and discharge. (NGET’s action has already been agreed at the GCRP in November 2010).

2. Ensure that NGET perform a Cost Benefit Analysis for any changes proposed in (1) above.

3. Ensure that NGET assess the risk to the NETS of legacy plant and consider a retrospective application of the Grid Code change.

4. For existing projects or those under construction (pending the Grid Code change), define an interpretation of the current Grid Code “continuous” in relation to voltage as either:

    a. In defining “continuous” - ignore the time delay in the second switching operation of a capacitor or reactor.

    Or

    b. Define “continuous” in the current Grid Code to mean a minimum of 15 seconds (close-open-close) and 2 seconds (capacitor discharge) for an indefinite number of repeat operations.

    Or

    c. Define “continuous” in the current Grid Code to mean a minimum of 15 seconds (close-open-close) and 2 seconds (capacitor discharge) for second switching operation with no specified requirement for a third switching operation.

5. To assess any potential discrimination issues, ask NGET to provide a list of all projects which have switched voltage control equipment commissioned to date, clearly showing the capabilities and indicating where NGET has demanded a change to capabilities and where FONs have been issued or have not yet been issued.

B. Make Code changes to manage different interpretations of the Code:

6. Ask NGET to bring forward a change to the General Conditions of the Grid Code to require NGET to bring to the Panel any issue of interpretation of the Grid Code where two or more Users are disputing NGET's interpretation and for such a report to be a standing agenda item for Panel meetings.

7. Ask NGET to report under KPIs on the speed of resolution of matters of interpretation requested by Users.

8. To provide a Web based facility for Users to request such interpretations.

[GCRP Decision (to be completed by the Committee Secretary following the GCRP) The Grid Code Review Panel determined that this issue should:

INSERT GCRP DECISION]