

Grid Code Review Panel
Suppression of Sub Synchronous Resonance from Series Compensators

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Summary

Relevant Transmission Licensees are in the process of procuring Series Capacitive Compensation (SCC) equipment to increase boundary power transfer capability. It is known that such devices can cause sub-synchronous resonance at frequencies that can interact with the natural torsional modes of synchronous generators. To avoid potential damage to synchronous generating units it is proposed that the Grid Code requires such installations to employ damping to remove the risk of unwanted interactions.

Users Impacted

High

Medium

Transmission Owners, System Operator, Generators

Low

Description & Background

A power system comprises a number of elements, many of which comprising of mechanical, electrical, electromechanical and electronic systems. All of these elements, when connected within the total power system, will have resonant oscillatory modes at a range of frequencies. These resonances can be excited by disturbances to the system, such as routine switching events or sudden changes in demand. Most oscillations are harmless and short lived because of the effective damping inherent within the system. However, under exceptional circumstances these oscillations can grow in magnitude, and if not controlled, cause plant damage or system instability.

The rotating shaft system of a turbine generating unit has inherent torsional oscillation frequencies which are determined by its large inertia masses and the interconnected shaft system. If the associated frequencies reflected at the terminals of the generator are close to the characteristic frequencies of the connected electrical power system and insufficiently damped, there will be unfavourable interaction between the two systems. The problem generally lies in the sub-synchronous frequency range (frequencies below 50Hz) as those in the super-synchronous range tend to be well-damped.

The high speed active controls deployed in a number of power system technologies, including High Voltage Direct Current (HVDC) equipment, have the potential to exacerbate sub-synchronous oscillations by providing negative damping. Equally, if explicitly designed to do so, they can provide positive damping and mitigate any risks of adverse oscillatory effects occurring.

Changes to the transmission network configuration will have the impact of changing the resonant modes of the overall power system. Series Capacitive Compensation (SCC) has

¹ The Code Administrator will provide the paper reference following submission to National Grid.

been identified as a key tool in maximising the transfer capability of the current overhead line network across Great Britain, with the potential advantage of reducing the infrastructure required. However the negative impact of SCC's is the potentially significant impact on resonant frequencies.

The application of HVDC technology on the transmission system will grow significantly over the next few years alongside the deployment of SCC solutions. There is therefore a current need to consider subsynchronous resonance on a regular and ongoing basis. New provisions have recently been incorporated into the Grid Code to specify the information required from synchronous generators to allow sub-synchronous resonance to be assessed. (GC0040 was approved for implementation on 19 August 2013)

The Grid Code currently places a duty on DC Converters not to cause a subsynchronous resonance problem on the Total System, CC6.3.16(a), but makes no reference to Series Capacitive Compensation installations.

Proposed Solution

It is proposed that the Grid Code is modified to require Relevant Transmission Licensees to provide sub-synchronous resonance damping control facilities to series capacitive compensation installations installed on the transmission system whenever it occurs in the range that could cause unwanted interactions with synchronous generating units.

Assessment against Grid Code Objectives

(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;

The deployment of SCC's can facilitate increased power transfer across transmission boundaries and can be engineered to avoid putting synchronous generating units at risk from SSR.

(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);

By ensuring that wherever SCC's are deployed in the transmission system local generation is not exposed to the risk of SSR interactions.

(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

Without certainty of SSR damping from SCC's some generators may be required to install monitoring and this may require consideration of shutting plant down to remove the risk of damage.

(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.

It is a matter of discrimination if HVDC owners are required to avoid causing SSR interactions but RTL's have no such requirement for SCC's

Impact & Assessment

Impact on the National Electricity Transmission System (NETS)

Yes positively by ensuring the security of supply is maintained.

Impact on Greenhouse Gas Emissions

No

Impact on core industry documents

Grid Code connection conditions

Impact on other industry documents

No

Supporting Documentation

Have you attached any supporting documentation No

If Yes, please provide the title of the attachment:

Recommendation

The Grid Code Review Panel is invited to:

Progress this issue to Industry Consultation

Document Guidance

This proforma is used to raise an issue at the Grid Code Review Panel, as well as providing an initial assessment. An issue can be anything that a party would like to raise and does not have to result in a modification to the Grid Code or creation of a Working Group.

Guidance has been provided in square brackets within the document but please contact National Grid, The Code Administrator, with any questions or queries about the proforma at grid.code@nationalgrid.com .