Paris Session 2022

Synchronous Grid forming Controllers

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Does the industry need to develop a standard definition of grid forming functionalities including details of controls, response time, ramping rate?

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Synchronous Grid Forming Controllers

- Grid ForMing (GFM) Converter controllers already exist today for HVDC but are used when the connected AC system is islanded, e.g., wind or solar farm.

- Development required is to integrate *Grid Forming* capability into HVDC converters connected into complex grids comprising multiple sources acting so that these converters are able to operate in parallel with other AC frequency regulating equipment and converters. This type of control is defined as ***Synchronous* Grid Forming**.

- CIGRE Science & Engineering, Vol. No. 15, October 2019

TF-77 - AC fault response options for VSC HVDC converters

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1. Introduction

The traditional AC power system has been dominated by synchronous generation. Two specific properties of this form of generation that have been exploited by power engineers designing AC power systems are:

- the potential energy stored in the inertia of the rotor which can be used to stabilise the AC system frequency and
- the dynamic over-current inherently supplied by a generator when the AC side terminal voltage suddenly drops and/or changes angle.

Today the power system is changing, moving away from the traditional fossil fuel-based thermal generation and moving towards an AC system with a large amount of renewable generation along with an increasing number of DC transmission connections. Renewable energy is commonly connected to the grid via a Power Electronic (PE) interface which does not naturally exhibit the same properties as synchronous generation. Eventually, as the trend to decommission older fossil fuel-based generation in favour of renewable sources continues, there will be less synchronous generation and hence less inertia and less dynamic over-current, unless these can be realized by alternative means.

The increase in PE's connecting generation to the grid raises the question of whether these PE interfaces can be made to emulate the same behaviour as synchronous machines and thereby, from the AC power systems designer's perspective, reducing or even eliminating the impact of having less synchronous generation. Some power system utilities have already tried to address this by proposing new grid codes, requiring PE converters,

KEYWORDS
Frequency, Inertia, Modular Multilevel Converter (MMC), Voltage Source Converter (VSC), Weak grids

Group Discussion Meeting

Synchronous Grid Forming Controllers

Today, a quick review of the literature will uncover several lists of definition for Grid-Forming but, whilst these lists contain many overlaps, there are also inconsistencies. A very basic definition, that can be drawn from these references, is that a Grid-Forming converter should :

- Act as a voltage source (both PPS and NPS), and
- Should apply current limits in a way that has the least negative impact on the AC system whilst maintaining the integrity of the converter rating

- More agreed functional description would benefit the market:
- Improve ability to plan a future HVDC scheme against a known behavioural response
- Assist vendors in developing their solutions against a known market need

However, the requirements should remain at a functional level and not dictate implementation methods as this may constrain some vendors due to Intellectual Property restrictions, thereby stifling the market but, also, limiting innovation. Hence, defining response envelopes against defined test cases would be a practical way forward for the industry.