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Extrinsic Power Plant with DC/AC/AC Converter for Low Frequency AC Transmission

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Abstract

In this paper, a unique LFAC transmission topology is analyzed. The projected system differs from previous work in that the wind turbines area unit assumed to be interconnected with a medium-voltage (MV) dc grid, in distinction with current follow, wherever the employment of MV ac assortment grids is normal. DC assortment is turning into a possible alternative with the event of efficient and reliable dc circuit breakers, and studies have shown that it'd be advantageous with relevancy an assortment in terms of potency and improved production prices.

This paper presents a low-frequency ac (LFAC) gear mechanism for offshore alternative energy. The LFAC system is interfaced with the most grids with a cyclo converter. The alternative energy plant assortment system is dc primarily based, and connects to the LFAC cable with a 12-pulse thyristor convertor. A technique to style the system's elements and controls is about forth. Simulation results area unit provided let's say the system's performance.

Keyword: High voltage AC, High Voltage DC, Thyristor Converters and Wind Forms

Introduction

Offshore alternative energy plants area unit expected to represents major factor of the long run electrical generation portfolio thanks to bigger house handiness and higher wind energy potential in offshore locations. The mixing of offshore alternative energy plants with the most grid may be a subject of current analysis. Presently, high-voltage ac (HVAC) and high-voltage dc (HVDC) area unit well-established technologies for transmission.

HVAC transmission is advantageous as a result of it's comparatively easy to style the protection system and to alter voltage levels exploitation transformers. However, the high capacitance of submarine ac power cables ends up in wide charging current, which, in turn, reduces the active power transmission capability and limits the transmission distance. HVAC is adopted for comparatively short (up to 50–75 km) underwater transmission distances.

In general, the most advantage of the LFAC technology is that the increase of power capability and transmission distance for a given submarine cable compared to 50-Hz or 60-Hz HVAC. This ends up in substantial price savings thanks to the reduction in cabling needs (i.e., less lines in parallel for a desired power level) and also the use of traditional ac breakers for cover.

Circuit Diagram

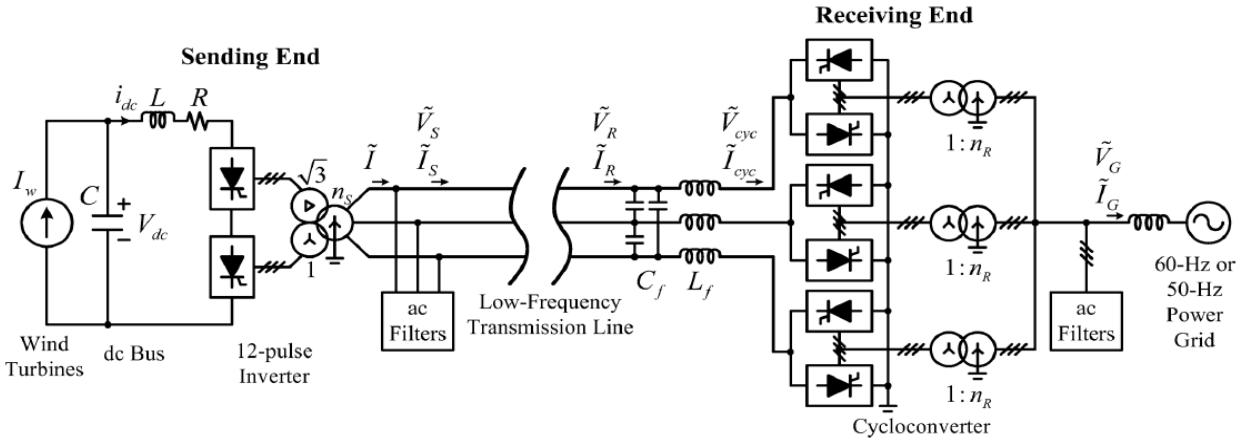

Fig: Configuration of the projected LFAC gear mechanism

The projected LFAC system can be designed with commercially offered grid elements, like the receiving-end transformers and submarine ac cables designed for normal power frequency. The phase-shift electrical device used at the causation finish can be a 60-Hz electrical device derated by an element of 3, with a similar rated current however solely simple fraction of the initial rated voltage. Another advantage of the projected LFAC theme is its practicability for multi terminal transmission, since the look of multi terminal HVDC is sophisticated, however the associatealysis of such an application isn't undertaken herein. In summary, LFAC transmission can be a pretty technical resolution for medium-distance transmission (i.e., in between HVAC and HVDC).

The electricity production from the renewable sources becomes a lot of engaging within the last decade. Amid offered renewable energy conversion technologies, the penetration of wind energy within the grid is increasing speedily. With the goal of Europe, the wind energy capability can increase to just about two hundredth of the entire energy capability. Larger wind farms with size from one hundred MW to a thousand MW area unit expected to be made within the next decade.

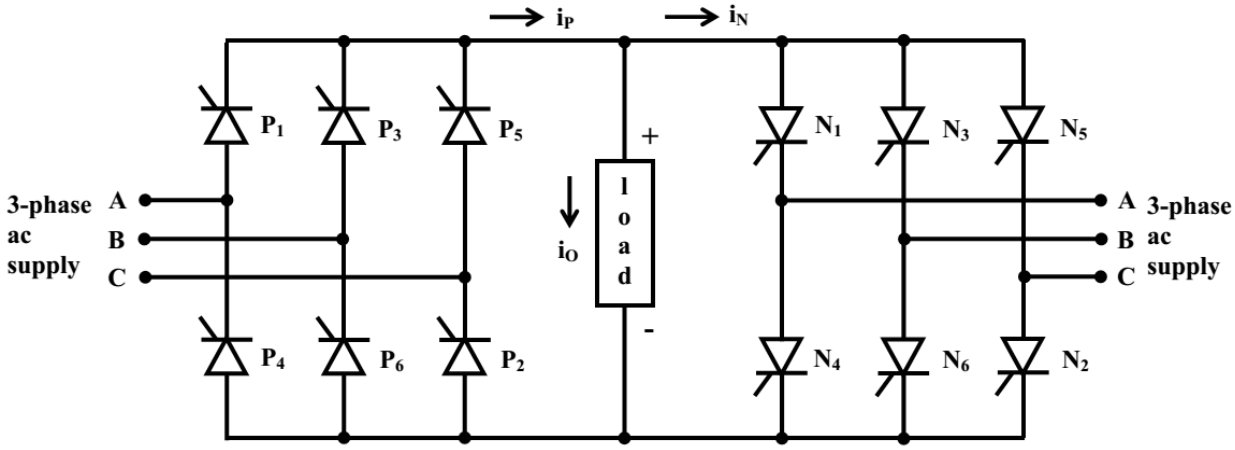

Fig: Three-phase to single-phase cycloconverter

The procedure to be followed in the triggering of the thyristors in sequence in the two bridges converters has been briefly given earlier. As given in the earlier, the firing angle (α) of two converters is first decreased starting from the initial value of 90degree to the final value of 0, and then again increased to the final value of 90degree, as shown in Fig. Also, for

positive half cycle of the output voltage waveform, bridge 1 is used, while bridge 2 is used for negative half cycle. The two half cycles are combined to form one complete cycle of the output voltage, the frequency being decided by the number of half cycles of input voltage waveform used for each half cycle of the output. As more no. of segments of near 60(π/6) is used, the output voltage waveform becomes near sinusoidal, with its frequency also being reduced

Result

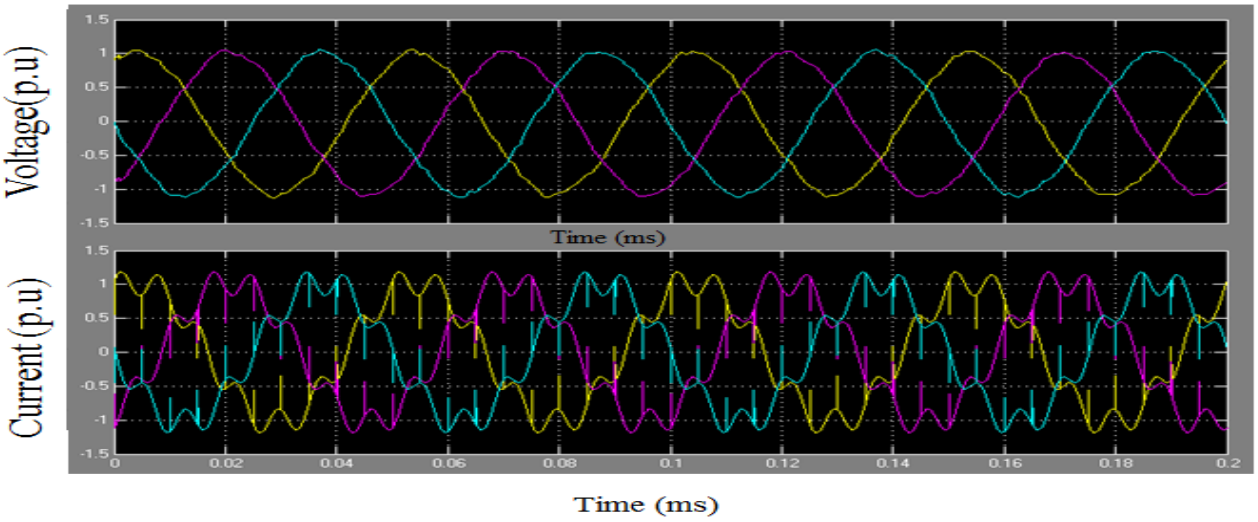

Fig: Voltage and current waveforms at sending

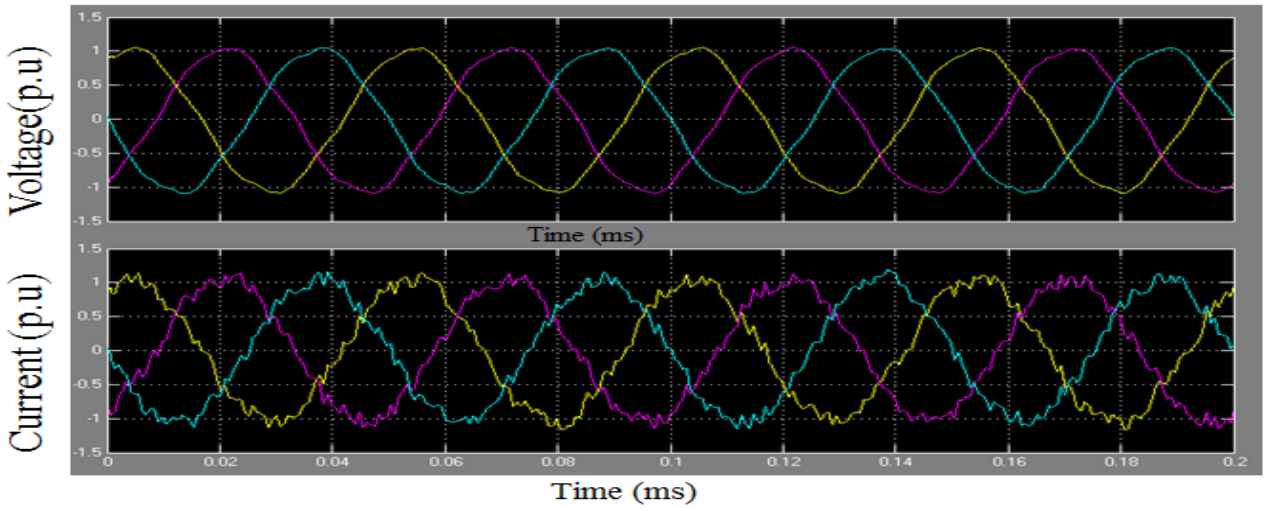

Fig: Voltage and current waveforms at receiving end

Conclusion

A low-frequency ac transmission system for offshore wind power has been proposed. A method to design the system's components and control strategies has been discussed. The use of a low frequency can improve the transmission capability of submarine power cables due to lower cable charging current. The proposed LFAC system appears to be a feasible solution for the integration of offshore wind power plants over long distances, and it might be a suitable alternative over HVDC systems in certain cases. Furthermore, it might be easier to establish an interconnected low-frequency ac network to transmit bulk power from multiple plants. In order to make better-informed decisions, it is necessary to perform a

complete technical and economic comparison among HVAC, HVDC, and LFAC, evaluating factors, such as the transmission efficiency, investment and operating costs, and the performance under system transients.

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