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TRANSMISSION OF AC POWER FROM OFFSHORE TO ONSHORE BY USING LOW FREQUENCY AC TRANSMISSION

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Abstract- *Now a days, renewable energy sources became a most vital part to promote power generation. There are so many types of renewable energy sources but one of the most emerging power generation technology is offshore wind power. In this project, integration of offshore wind power plants with the main power grid by the help of low frequency AC transmission is described. The wind power plant collection system is dc based and connects to the LFAC transmission line with a 12 pulse thyristor converter. A method to design the system's components and controls is set forth. Simulation results are provided to illustrate the system's performance.*

Key words: Power transmission, thyristor converter, underwater power cables, wind energy.

1. INTRODUCTION:

Offshore wind power or offshore wind energy is the use of wind farms constructed in bodies of water, usually in the ocean on the continental shelf, to harvest wind energy to generate electricity [1]. Higher wind speeds are available offshore compared to on land, so offshore wind power's contribution in terms of electricity supplied is higher, and NIMBY opposition to construction is usually much weaker. Unlike the typical usage of the term "offshore" in the marine industry, offshore wind power includes inshore water areas such as lakes, and sheltered coastal areas, utilizing traditional fixed-bottom wind turbine technologies, as well as deeper-water areas utilizing floating wind turbines.

Fixed foundation offshore wind farms employ turbines with fixed foundations underwater, installed in relatively shallow waters of up to 50–60 m. Almost all currently operating offshore wind farms are of fixed foundation type, with the exception of a few pilot projects. Types of underwater structures include monopole, tripod, and jacketed, with various foundations at the sea floor including monopole or multiple piles, gravity base, and caissons.[32] Offshore turbines require different types of bases for stability, according to the depth of water. The advantage of locating wind turbines offshore is that the wind is much stronger off the coasts, and unlike wind over the continent, offshore breezes can be strong in the afternoon, matching the time when people are using the most electricity.

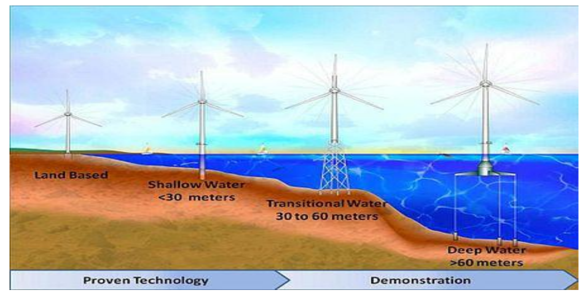

Fig 1.1 Offshore wind turbine evolution to deeper water

1.1 Classification of transmission:

HVAC transmission is advantageous because it is relatively straightforward to design the protection system and to change voltage levels using transformers. However, the high capacitance of submarine ac power cables leads to considerable charging current, which in turn, reduces the active power transmission capacity and limits the transmission distance. HVAC is adopted for relatively short (up to 50–75 km) underwater transmission distances. Two classes of HVDC systems exist, depending on the types of power-electronic devices used: 1) line-commutated converter HVDC (LCC-HVDC) using thyristors and 2) voltage-source converter HVDC (VSC-HVDC) using self-commutated devices, for example, insulated-gate bipolar transistors (IGBTs).

LCC-HVDC systems are capable of handling power up to 1 GW with high reliability. LCCs consume reactive power from the ac grid and introduce low-order harmonics, which inevitably results in the requirement for auxiliary equipment, such as capacitor banks, ac filters, and static synchronous compensators. On the other hand, VSC-HVDC systems are able to independently regulate active and reactive power exchanged with the onshore grid and the offshore ac collection grid. The reduced efficiency and cost of the converters can be identified as drawbacks of VSC-HVDC systems. Power levels (typically on the order of 300–400MW) and reliability are lower than those of LCC-HVDC. HVDC is applied for distances greater than 100 km for offshore wind power transmission[3].Besides HVAC and HVDC, high-voltage low-frequency ac LFAC transmission has been recently proposed. In LFAC systems, an intermediate-

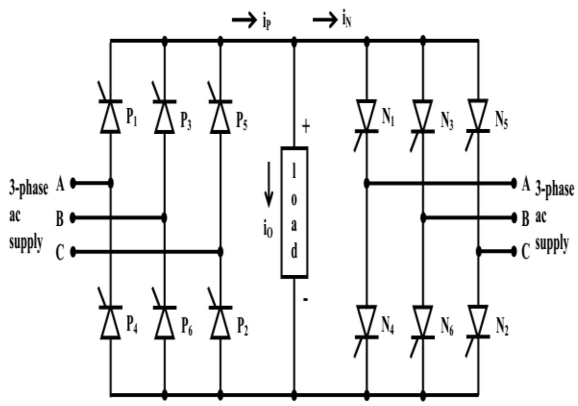

Fig 2.4 Three phase to single phase cycloconverter

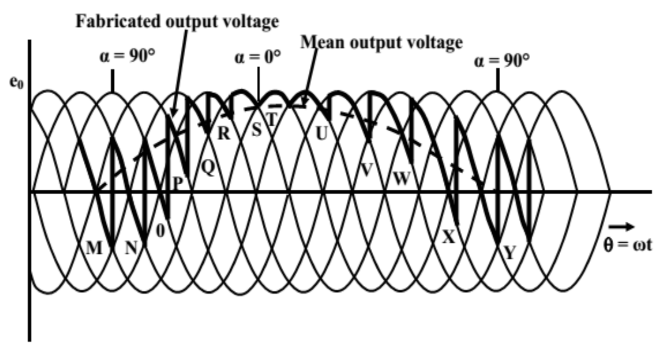

Fig.2.5 Output voltage waveforms for a three-phase to single phase cycloconverter.

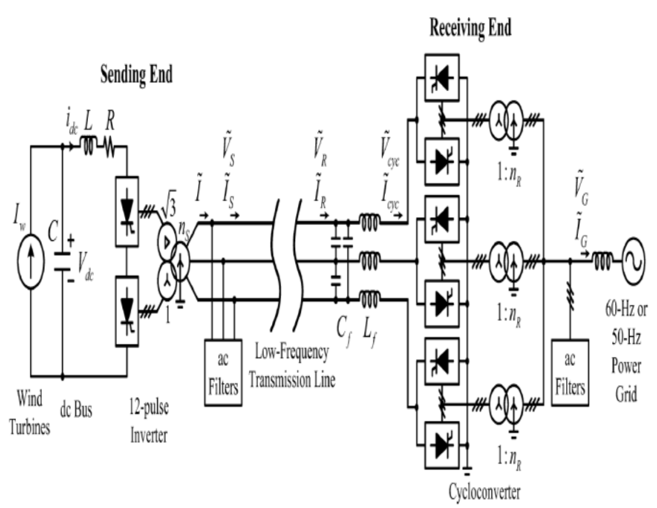

Fig.2.6 Configuration of the proposed LFAC transmission system.

The proposed LFAC system could be built with commercially available power system components, such as the receiving-end transformers and submarine ac cables designed for regular power frequency. The phase-shift transformer used at the sending end could be a 60-Hz transformer derated by a factor of three, with the same rated current but only one-third of the original rated voltage. Another advantage of the proposed LFAC scheme is its feasibility for multi terminal transmission, since the design of multi terminal HVDC is complicated, but the analysis of such an application is not undertaken herein. summary, LFAC transmission could be an attractive technical solution for medium-distance transmission (i.e., in between HVAC and HVDC.

3. CONTROL SYSTEM

3.1 Controller:

A controller is a device introduced in the system to modify the error signal and to produce a control signal. The manner in which the controller produces the control signal is called control action. It can be introduced in the feedback or forward path of the system, which controls the steady state and transient response as per the requirement

Depending on the control action provided, the controllers can be classified as follows

1. Proportional controller
2. Integral controller
3. Derivative controller
4. Proportional plus integral controller
5. Proportional plus derivative controller
6. Proportional plus integral pulse derivative controller

3.2 PI Controller:

As the name suggests it is a combination of proportional and an integral controller the output (also called the actuating signal) is equal to the summation of proportional and integral of the error signal.

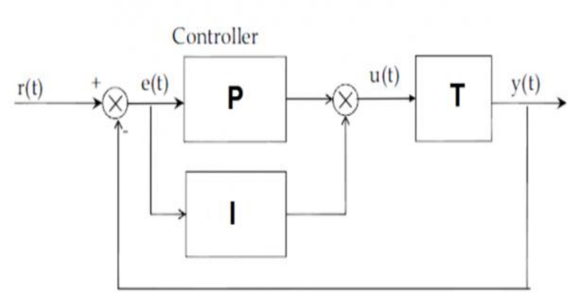

Fig 3.1 Block diagram of PI controller

3.2.1 Advantages of proportional and integral controller:

1. It's used to ensure long-term system precision.
2. It's almost always used together with P controller.
3. The controller sums up the errors until it reaches a reference value.
4. A pure integral control system is very slow and can sometimes determine system oscillations.

3.3 System Parameters:

Sending end:

Dc bus capacitor	C=1000μf
Smoothing indicator	L=0.1μH,R=1 mΩ
20 Hz phase shift transformer	
Rate power	214 MVA
Winding Resistance	0.001 P.U
Magnetizing resistance	1000 P.U
Leakage reactance	0.05 P.U
Magnetizing Reactance	200 P.U

AC Filters:

	R(Ω's)	L(mH)	C(μf)
11th	0.41	29.7	17.6
13th	0.35	21.3	17.6
>23rd	19.7	6.8	17.6

Transmission cable:

R(ohms)	17.6 Ω/km	L(Henry)	0.35 mH/km
C(farad)	0.25 μf/km	Rated current	82475 A

Receiving end:

LC FILTER		Lf=63Mh	Cf=8.7μF
Trans formers			
Rated power	100MUA	Voltage	132/88KV
Winding Resistance	0.001 P.u	Leakage Reactance	0.05 P.u.
Magnetizing Resistance	1000 P.u.	Magnetizing Reactance	200 P.u.
ac Filters(200MVAr,B2KV,60Hz)			
	R(Ω)	L(mH)	C(μF)
3rd	1.16	102.7	7.6
5th	0.70	37.0	7.6
7th	0.50	18.9	7.6
>9th	38.7	11.4	7.6

4. SIMULATION RESULTS:

The power which is generated by wind turbine is send to the dc bus for constant and smoothing purpose. Than, it is passed through 12-pulse inverter , it converts into low frequency and to cyloconverter is uesd to increase the lowfrequency to highfrequency according to the power grid requirement.AC filters are prvided to reduce the harmoncs. The system was simulated by using MATLAB Simulink Software.

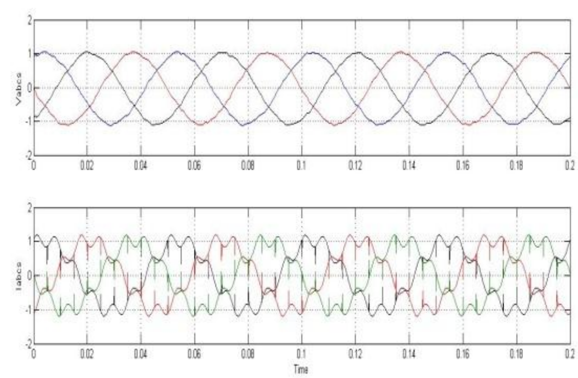

Fig 4.1 voltage and current waveforms at Sending end side

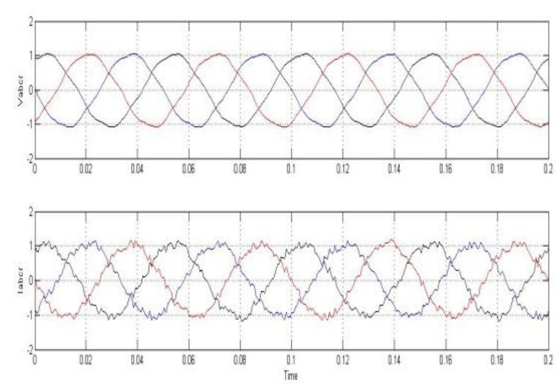

Fig 4.2 voltage and current waveforms at Recieving end side

transmission system", presented at the IEEE Power Energy Soc. Transm. Distib. Conf. Expo, Orlando, FL, (2012) May.

[6] S. Lundberg, "Evaluation of wind farm layouts," presented at the Nordic Workshop Power Ind. Electron., Trondheim, Norway, Jun 2004.

[7] Ma Weimin, Wu Fangjie, Yang Yiming, Zhang Tao. Analysis of the current status and application prospect of flexible HVDC technology [J]. high voltage technology, 2014,08:2429-2439.

[8] Lu Jin Du, Wang Zhijie, Wang Haiqun, Huang Qiyuan, Wang Haoqing, Du Bin. Research on the technology and application of flexible HVDC [J]. Journal of electric power, 2015,04:293-300.

[9] H. Li, B.Ozpineci and B.K.Bose, "A Soft-Switched High Frequency Non-Resonant Link Integral Pulse Modulated DC-DC Converter for AC Motor Drive", Conference Proceedings of IEEE-IECON, Aachen/Germany, 1998, vol. 2, pp 726-732

[10] B. K. Bose, Power Electronics and Ac Drives, Prentice-Hall, New Jersey, 1986.S