HVDC Tie line Simulation

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Abstract---High Voltage Direct Current (HVDC) technology has made considerable advancements in recent years. The HVDC system has been studied to understand HVDC components, their advantages over the conventional ac transmission systems and their implementation with transmission system. The main objective is to determine bidirectional power flow analysis. Also determine the automatic control of rectifier gate signal and automatic control of inverter gate signal. Also whenever any fault occur in DC line at that time we can automatic control the firing angle to prevent the fault. Simulation has been carried out by MATLAB software. In this paper at both the end we can connect the load as a motor and thereafter we can determine the bidirectional power flow analysis. The gate pulse is applied manually.Then after we can check the result of the system.

Key Words: HVDC Tie Line, Bidirectional Power Flow Analysis, MATLAB Simulation

I. INTRODUCTION

The High Voltage Direct Current electric power transmission system uses direct current for the bulk transmission of electrical power, in contrast with the more common alternating current (AC) systems. For long-distance transmission, HVDC systems may be less expensive and suffer lower electrical losses. For underwater power cables, HVDC avoids the heavy currents required to charge and discharge the cable capacitance each cycle. For shorter distances, the higher cost of DC conversion equipment compared to an AC system may still be warranted, due to other benefits of direct current links. HVDC allows power transmission between unsynchronized AC transmission systems. Since the power flow through an HVDC link can be controlled independently of the phase angle between source and load, it can stabilize a network against disturbances due to rapid changes in power. HVDC also allows transfer of power between grid systems running at different frequencies, such as 50 Hz and 60 Hz. This improves the stability and economy of each grid, by allowing exchange of power between incompatible networks. High voltage is used for electric power transmission to reduce the energy lost in the resistance of the wires. For a given quantity of power transmitted, doubling the voltage will deliver the same power at only half the current. Since the power lost as heat in the wires is proportional to the square of the current for a given conductor size, but does not depend on the voltage, doubling the voltage reduces the line losses. High voltage AC-DC technology has made considerable advances in recent years. Engineers are now considering DC multi-terminal network as a feasible option. Therefore, the load flow and state estimation techniques are extended to deal with such mixed AC-DC systems. Multi-terminal DC network integrated into an existing system can improve AC equipment loading and stability, participate in load frequency control and voltage regulation, increase interchange capacity, limit short circuit capacity and contribute to the economy of electric power transmission.

II. BIPOLAR CONFIGURATION

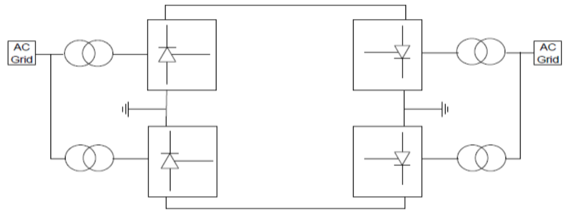

Fig. 1: Bipolar schemes

The bipolar scheme is one of the most common schemes and is effectively a combination of two monopolar schemes. One pole would be positive and the other negative with reference to ground potential. The two monopolar schemes share the same earth return and can be operated one at a time with earth return during at outage on the other monopolar scheme. During balanced bipole operation, virtually zero current will flow in the earth return. Fig. shows the typical layout of a bipolar HVDC scheme.

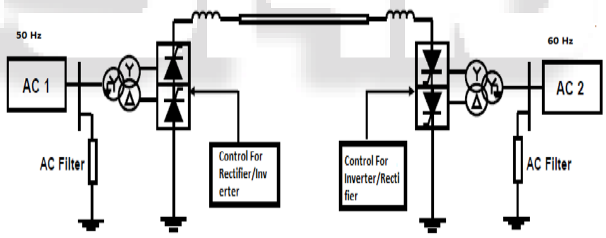

Fig. 2: Monopolar HVDC Model

The configuration of the system is given in figure. The AC networks, both at the rectifier and inverter end, are modelled as infinite sources separated from their respective commutating buses by system impedances. From the AC point of view, an HVDC converter acts as a source of harmonic current. From the DC point view, it is a source harmonic voltage. The order n of theses characteristic harmonics are related to the pulse number p of the converter configuration: $n = kp \pm 1$ for the AC current, and $n = kp$ for the direct voltage, k being any integer. In the example, $p = 12$, the injected harmonic are: 11, 13, 23, 25 on the AC side, and: 12, 24 on the DC side .

III. EXPERIMENTAL PARAMETER

3-phase source:200KV
Star/star-delta transformer: 200KV/600KV
Star-star/Delta transformer: 600KV/200 KV
Transmission line : 300 Km

IV. EXPECTED OUTCOMES OF PROPOSED WORK

A. *12-PULSE RECTIFIER*

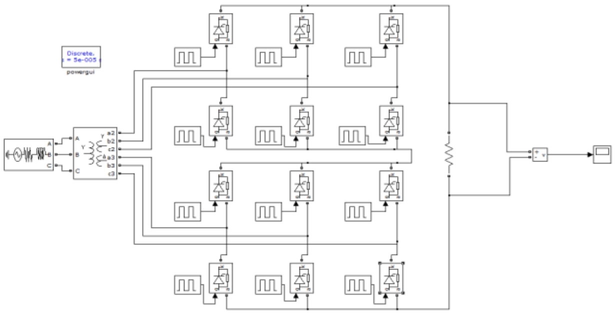

Fig. 3: 12-Pulse Rectifier

B. *Bridge Inverter*

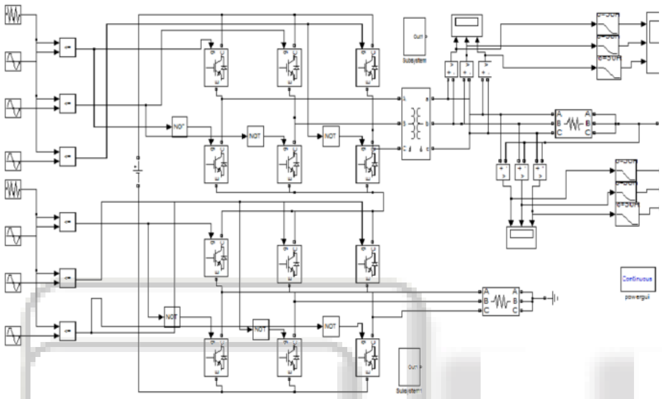

Fig. 4: 3-Phase Bridge Inverter

C. *Combine 1-Line Diagram*

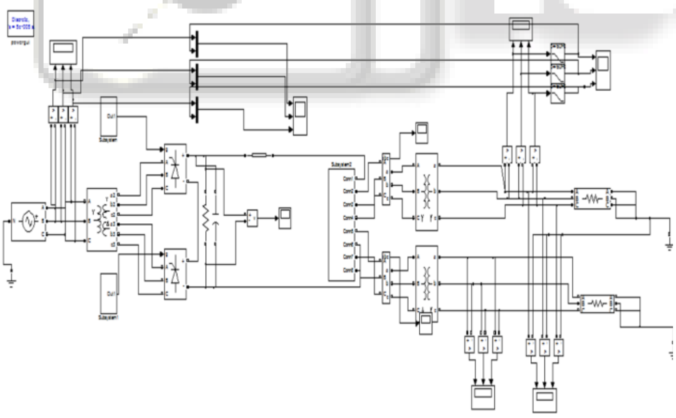

Fig. 5: Combine 1-line diagram

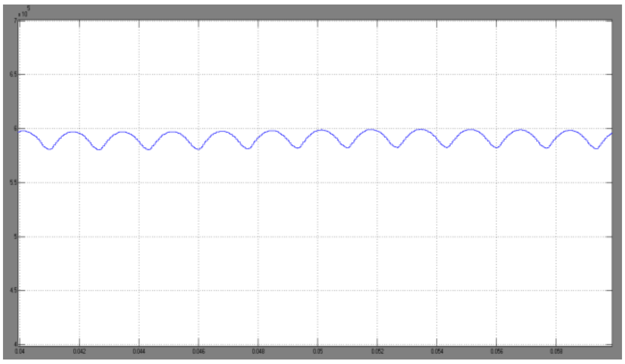

Fig. 6: Output voltage waveform of Rectifier

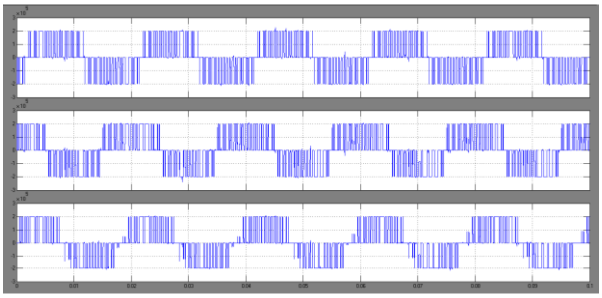

Fig. 7: Line to line Voltage

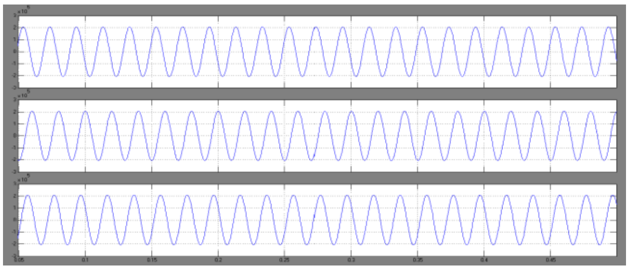

Fig.8: Line to line Voltage using filter

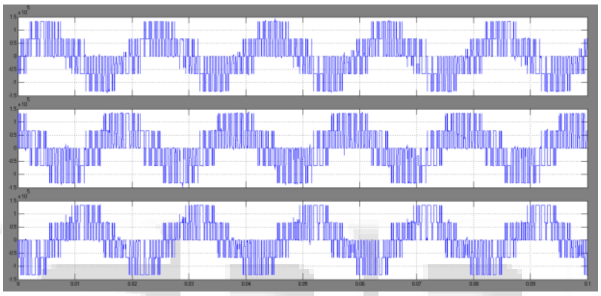

Fig. 9: Phase to neutral Voltage

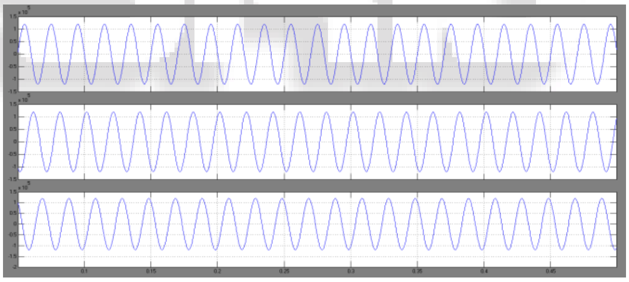

Fig.10: Phase to neutral Voltage using filter

The modelling of a high-voltage direct current (HVDC) transmission link using 12-pulse thyristor converters are applied to examine the system performance. The objectives of this to demonstrate the use of SimPower Systems blocks in combination with Simulink blocks in the simulation of a complete pole of a 12-pulse HVDC transmission system. The Discrete HVDC Controller block is a generic control available in the Discrete Control Blocks library of the SimPower Systems Extras library. DC interconnection is used to transmit power from a 200 kV,50 Hz system to a 60 Hz system.

The12-pulse rectifier and the inverter converters connected in series. Open the two converter subsystems (Rectifier block and Inverter block) to see how they are built. The converters are interconnected through a 300-km line and 0.5 H smoothing reactors. The converter transformers (Wye grounded/Wye/Delta) are modeled with Three-Phase Transformer (Three-Windings) blocks .

V. Conclusions

From the simulation we can conclude that for the single line diagram we can transmit the power from 50 Hz to 60 Hz system and we can balance the load.

VI. Future Enhancement

Now i am completed up to single line diagram of HVDC tie line with monopolar configuration and we can transmit the power from one AC network to other. In future i am used bipolar HVDC line and we can do simulation and we get the result. Also the automatically gate pulse are generated and applied automatically to the rectifier as well as inverter side and we get the result.

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