HVDC Light Power Flow Modelling

Assignment No. 2

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***Abstract*—The power system analysis and design is generally done by using power flow analysis. The objective of this project is to develop a MATLAB program to calculate voltages and phase angle, active and reactive power at each bus using the Newton-Raphson method. At first IEEE 5 bus system is calculated with MATLAB Program and then IEEE 14 bus system MATLAB program is executed with the HVDC Light model with input data. This type of analysis is useful for solving the power flow problem in different power systems which will useful to calculate the unknown quantities and improve the voltage profile in nearby buses.**

***Index Terms*—HVDC, voltage source (VSC), voltage magnitudes (V), active power (P), reactive power (Q), Newton-Raphson (NR) method**

I. Introduction

Innovative solutions with HVDC and FACTS have the potential to manage new challenges. By means of Power Electronics, they provide features which are necessary to avoid technical problems in the power systems, they increase the transmission capacity and system stability very efficiently and help prevent cascading disturbances. HVDC light is high voltage direct current transmission system based on solid state voltage source technology utilizes most advanced power electronics and semiconductors [1].

HVDC Light is the most recent HVDC technology based on Voltage Source Converters (VSC) and extruded DC cables with power units up to 200 MW. HVDC Light converters include Insulated Gate Bipolar Transistors (IGBTs) and operate with high frequency Pulse Width Modulation (PWM) in order to get high speed control of both active and reactive power. HVDC Light cable is a cable with insulation of extruded polymer and specifically adapted for direct voltage.

II. HVDC Light

The HVDC light comprises two voltage source converter (VSC), one operating as a rectifier other operating as inverter. The two converter are operating back to back OR joined together by DC cable. Its main function is to transmit constant dc power from rectifier to inverter station. The schematic representation of HVDC light shown in figure below.

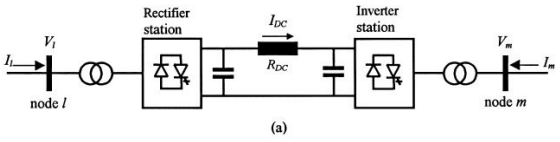

Fig. 1: HVDC Light model

The equivalent representation of HVDC light model is given below. One VSC converter control DC voltage the other control active power through the DC link.

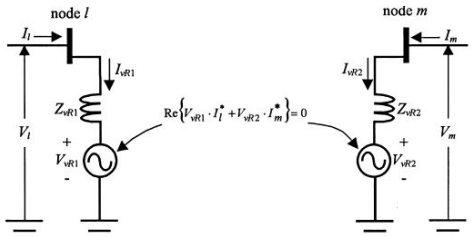

Fig. 2: Equivalent HVDC Light model

A. Comparison Between HVDC and HVDC Light

Conventional HVDC	HVDC light
Thyristor valve	IGBT valves
Converter transformer connects connection valve and AC grid.	Series reactor and transformer connects connection valve and AC grid.
50% filtering and reactive compensation in filters and shunt capacitor.	Only small filters are required for filtering and reactive power compensation.
DC current smoothing by smoothing reactor and DC filter.	Dc current smoothing by DC capacitors.

Fig. 3: Comparison between HVDC and HVDC Light

III. POWER FLOW ANALYSIS

A bus is a node at which one or many lines, one or many loads and generators are connected. In a power system each node or bus is associated with 4 quantities, such as magnitude of voltage, phage angle of voltage, active or true power and reactive power in load flow problem two out of these 4 quantities are specified and remaining 2 are required to be determined through the solution of equation. Depending on the quantities that have been specified, the buses are classified into 3 categories.

- Load bus
- Generator bus or voltage controlled bus
- Slack (swing) bus

A. Case: 1 IEEE 5 bus

A matlab program is written to calculate the bus voltages ,active power and reactive power and voltage phase at every bus in the system for every iteration.The input data for the program is given.

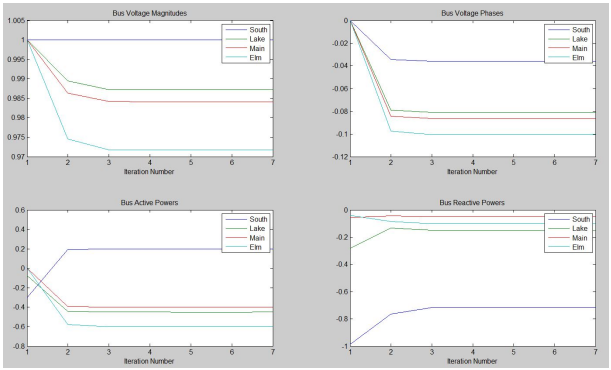

Fig. 4: voltage, phase, active, and reactive power

B. Case: 2 IEEE 14 bus

The IEEE 14 bus system is simulated for voltages ,active and reactive powers at each bus. The standard IEEE 14 bus system is shown in figure. A MATLAB program is used for IEEE 14 bus system with standard IEEE 14 bus system data. After simulating the program ,it displays results rectifier real power, rectifier voltage phase ,Inverter Reactive powers and Inverter voltage magnitude. The results of MATLAB program for IEEE 14 bus system are

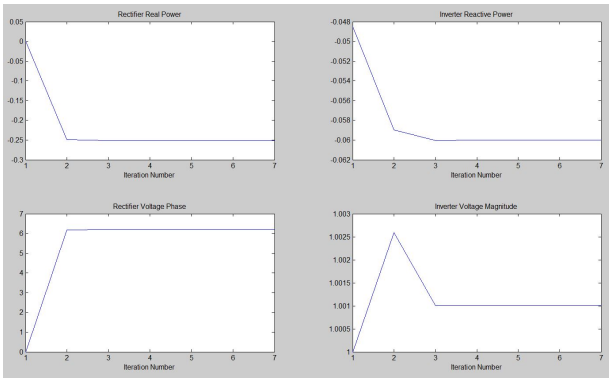

Fig. 5: Rectifier and Inverter voltage

IV. CONCLUSION

REFERENCES

[1] A. K. Mohanty and A. K. Barik, "Hvdc light and facts technology: A modern approach to power system interconnections," *International Journal of Engineering Research and Applications (IJERA) Vol*, vol. 2, pp. 1331–1336b.