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Enhanced Energy Management and Maintenance: A Simulation using Matlab Tool

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ABSTRACT

The goal of this study is to meet the power and energy demands of developing countries while also achieving the required economic status. International power contracts are signed for this purpose, and their power grids are imported. To achieve the purpose, a high-voltage direct current (HVDC) transmission connection is employed to connect separate grids in developed countries. Simulink of MATLAB is used to simulate the fundamental HVDC models at first. After that, the HVDC link is employed in a variety of situations, ranging from perfect to non-ideal. Then, other types of faulty conditions, such as three-phase fault and three-phase breaker, are used, and various non-ideal characteristics are investigated to evaluate how the models' performance and efficiency change.

1.Introduction

HVDC transmission is an efficient technology to transmit large amounts of electricity and also interconnect incompatible Alternating Current (AC) networks over bulk transmission with less expense and lower loss. HVDC can be transmitted through cables both underground and underwater [1].It is expensive compared to short distance AC system but for long distance, HVDC has its advantages. The increasing demand for power has put the whole transmission system under sheer pressure. Also, the efficiency of electricity supply systems is under great stress due to greenhouse gas considerations while the development of large hydroelectric designs is imperative to decrease the dependence on fossil fuel and natural gas for power generation which produces a large number of greenhouse gases. In addition, power and energy crisis is seriously influencing on economic growth and development of the developing countries. So, new effective ways are needed to meet the demands [1].
In response to this problem, we proposeto solve by signing international power contracts and importing their power grids. In this regard, HVDC is used to interconnect separate grids of those developed countries to transmit energy reliably and efficiently over large distances. Also, to maintain the stability of the system within the country, FACTS devices are added.

2.Related Works

In HVDC Systems, the three-level based converter is used over double converter since three-level based converter offers better sinusoidal voltage waveform, a Low voltage switching and also using several lower voltage levels will have a smaller stress on cables and motors. The first step is to convert LVDC to HVDC and then the HVDC is converted to AC by proper pulse width modulation.
There is another component which has a great influence on electrical transmission system known as Harmonic. To mitigate harmonic pollution many passive and active filters are used. They have two primary functions: 1) To compensate for part or all of the reactive power absorbed by the converter, 2) To limit the current distortion caused by the converter harmonics to an acceptable level [2].

3.The Proposed Structure

Fig. 1 shows a simple AC-AC sourced HVDC.This model consists of two AC sources which are denoted by system 1 and system 2.System 1 consists of three phase voltage source, series inductance and loads.System 2 consists of three phase source with internal RL impedance and three phase parallel RL branch.

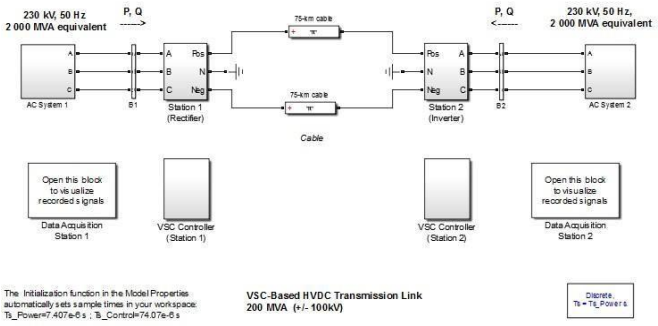

Fig. 1. VSC- HVDC Transmission System Model

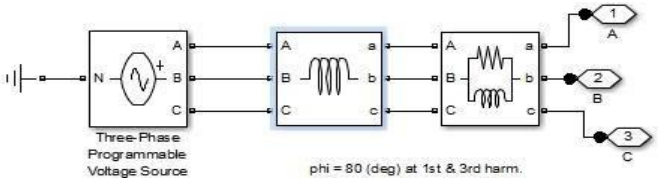

Fig. 2. System 1-Three phase source (block), three-phase series RL branch (block) and three phase parallel RL branch (block) are connected in series.

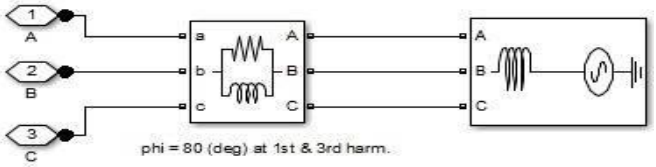

Fig. 3.System 2-Three phase source (block) and three phase parallel RL branch (block) are connected in series.

In Fig. 2 the system voltage, phase angle of phase 'a' and frequency are 230 KV, 0° and 50 Hz respectively. The internal connection is Yg and the source resistance is 0 Ω. The values of three phase parallel RL branch are 13.79Ω 3l.02 mH. The series inductance is 62.23 mH [3].

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4. Experimental Results

The entire analysis of this research is based on Matrix Laboratory (MATLAB) software. For the simulation Fast Fourier Transform (FFT) tool is used from the Powergui of MATLAB Simulink. At first we did Simulation of Three-Phase Fault in Single System in All AC-AC Source Modeled HVDC System.The fault occurs between 4 sec to 6 sec in a simulation time of 10 seconds.Fig. 4 shows, during fault the voltage in system 2 becomes zero. On the other side, the voltage remains stable in system 1 as shown in Fig. 5.The system 1 is not affected because of HVDC link. This is a proof of maintaining power system stability.

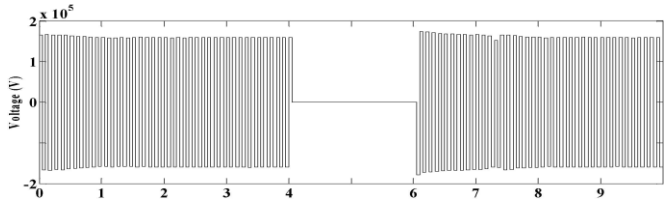

Fig. 4. Three phase fault in system 2.

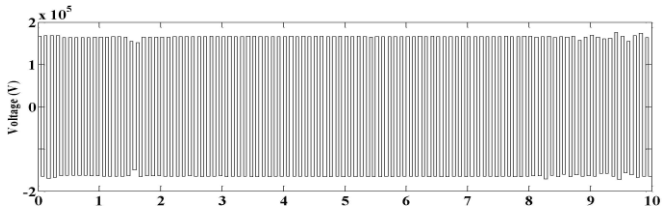

Fig. 5. System1 during the faultycondition in system 2.

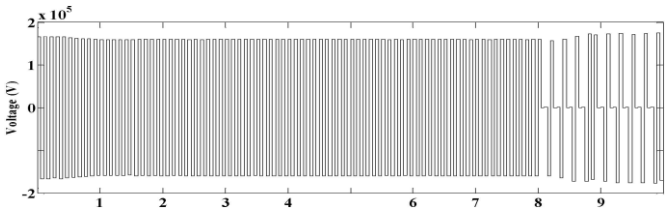

Fig. 6. Three phase breaker operation in system 2

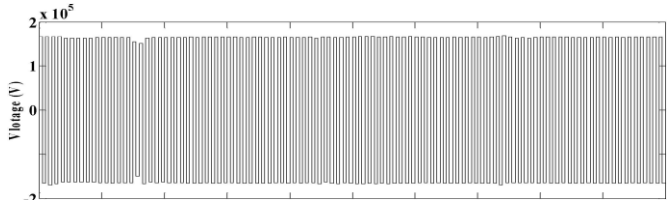

Fig. 7. System 1 during three phase breaker operation in system 2

And secondly we did simulation of Three-Phase Breaker in Single System in All AC-AC Source Modeled HVDC system. In this case, three phase breaker fault occurs in System 2 and FFT tool is used to simulate the faulty condition. The simulation time is 10 seconds. The breaker is set between 8 sec to 10 sec with 0. 1sec interval as shown in Fig. 6.Fig.6 shows switching (breaker) operation in system 2 but due to HVDC link system 1 is unaffected which is shown in Fig.7. This is another proof of maintaining power system stability.

5. Conclusion

The stability of the power system is shown from the simulation of MATLAB Simulink. It has observed that when fault occurs in one system other remains at their expected level. Flexible AC Transmission Systems (FACTS) could be added to the designed models. Inclusion of these devices would definitely enhance the performance and efficiency of the models. HVDC links and FACTS devices could be placed in the IEEE- 14 bus. It will help to show the benefit of using HVDC accurately and effectively.

Acknowledgment

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