King Saud University
College of Engineering
Electrical Engineering Department **Semester: 421**

Graduation Design Project Proposal Form

Project # P15

Project Title: Modeling and Control Design of VSC-HVDC Connected to Strong AC Grid

Professor(s) Name(s): 1. Mohammed Alharbi
2.

Number of Students: Three

Students Qualifications

1- Knowledgeable about MATLAB and Simulink
2- Basic of power electronics
3- Background of feedback control system
4- Background of the root locus theory and frequency response analysis using Bode plot

Statement of Problem

Typically, electrical energy is transmitted in an alternating current (AC) form because it is a simple solution. However, transmitting bulk power over a long distance is restricted, and connecting two AC systems with different frequencies is also infeasible with AC systems. The power flow changes based on load demands and generator capacities in AC systems, hence; the power is unmanageable. The high voltage direct current (HVDC) technology has been developed to overcome the limitations associated with AC grid transmissions. The AC grid voltage and current are transformed from the AC into the DC form in order to transmit the power through DC transmission lines. The voltage source converter (VSC) is the building block that is used to connect the AC grid to the DC grid. The control system of the VSC is challenging and needs to be carefully designed to ensure stability and output quality.

Brief Description of the Project

In this project, the VSC system and its system specifications will be developed in the MATLAB/Simulink software. The AC side of the VSC is connected to a strong AC grid while the DC side is connected to a DC power supply. The mathematical dynamic equations and the control system of the VSC will developed in the DQ reference frame. The root locus and frequency response analysis using Bode plot will be used to design the controller parameters of the VSC control system. The dynamic performance of the VSC system will be investigated under the steady state and transient conditions.

Objectives

(1) development and parameter specifications of the two-level voltage-source converter (2L-VSC) based HVDC,
(2) voltage and current controls using the DQ technique, and
(3) controller designs of the VSC-HVDC system using the root locus and frequency response (Bode plot) theories.
(4) validation and performance analysis of the VSC-HVDC system.

The VSC-HVDC system will be designed and built in the Simulink environment. The mathematical model of the VSC system will be developed in the DQ reference frame. The PI controller parameters will be designed and analyzed using the root locus and frequency response (Bode plot) theories. Finally, the performance of the VSC-HVDC will be studied to verify the control system designs.

Technical Approach and Expected Deliverables

The VSC system should precisely be able to control the voltage and current (active and reactive power) based on the reference commands entered by users.