ECE 529: Homework #3

Due Session 29 (March 27)

1. Implement an averaged model of a three phase VSC with an AC source voltage of 2.3 kV (L-L), \( R = 0.0096 \Omega \), \( L = 382 \mu H \) (X/R = 15) and a switching frequency of 3060Hz in a transient simulation program. The DC link has two 10,000 \( \mu F \) capacitors connected pole to ground. The output of the converter goes to a 2.3kV:24kV, 5 MVA, Y-Yg step up transformer with X = 0.08 pu on the transformer rating base and an X/R ratio of 15 and then connects to a power system with a Thevenin equivalent impedance \( Z = (0.05 + j 0.5) \) pu (on a base of 24 kV and 5 MVA) and an equivalent source voltage of 24 kV.

A. Implement a phase locked loop for a point of interconnect at the high voltage side of the transformer and test with ideal voltage sources on the dc link and a couple of P and Q ranging between 0 and 5 MVA total.

B. Replace the dc voltage sources with a capacitor banks in parallel with a current source behind a small resistance. Implement a dc bus voltage regulator to determine the direct axis current reference for the controls. Set up the DC current source to be able to ramp from an equivalent of 0 MW to 4 MW while the converter is at unity power factor.

C. Repeat part B with leading and lagging power factor operation at 0.8. Compare the magnitude of the voltage at the point of interconnect the two different power factor cases.

D. Repeat part B with the quadrature axis current reference determined by a closed loop voltage regulator set to maintain the voltage at the point of interconnect at 24 kV line to line.