ECE529 Homework #4

Due Session 34 (April 12)

A large industrial facility has a total load of 4MW load at unity pf, includes some loads that are sensitive to voltage sags that will trip when a sag lasting more than 4 cycles occurs. The plant is currently fed by a 13.8 kV distribution feeder. Your task is to rate a dynamic compensation scheme to correct for the voltage sags such that the RMS load voltage stays above 0.95 pu during a voltage sag down to 0.67 pu. A one-line diagram of the system is given below. All of the per unit impedances are on a 4 MVA base, with voltage bases starting from the equivalent source.

A. First consider using STATCOM, where a 3 phase fault occurs at the location shown. What is the MVA injection needed at the STATCOM location shown in the above figure (where it says STATCOM (part A), to raise the voltage to 0.95 pu until the fault is cleared. Calculate the real and reactive power the STATCOM needs to supply.

B. Instead, consider using a static series compensator with energy storage, such as a dynamic voltage restorer (DVR). Calculate what voltage the DVR must provide to compensate for the voltage sag in part A rather than using the STATCOM. If the sag lasts for 9 cycles, how much energy must the DVR supply?

C. Now suppose that the compensator of part B sees a 50% voltage sag on one phase with a 30 degree phase shift in the voltage on that phase during the sag. What is the magnitude and angle of the voltage that is needed to restore the voltage to 0.95 p.u. on that phase (you don't need to analyze the circuit to try to create this condition). How much energy must the DVR supply if the sag lasts for 9 cycles.