

ECE2795 Homework Assignment #3

Due date: 02/26/2015 at 6 pm.

For all questions elaborate some few conclusions or comments about the results. For all questions with simulations include a graph with the used model. State all the assumptions considered in the analysis. You are free to do as many assumptions or simplifications you consider appropriate.

1) Consider that you are using 20 Maxwell Boostcap BCAP2000 connected in series to provide energy to a 1 ohm resistive load. If at the initial time all capacitors are at their maximum voltage (2.7 V), how long will it take to discharge the capacitors to 50 % of their initial voltage? How long will it take to discharge them to 50 % of their energy? What is the maximum current during the discharge process? Is the maximum current of 4300 A exceeded? Now consider that you have a 5 kW constant-power load instead of the resistance with the same arrangement and initial voltage. Please, find $v(t)$ and calculate what is the minimum discharge voltage with this load.

2) Consider that you are operating a MCFC with an output of 48 V. Suddenly, the load increases in 10 kW. The MCFC takes 5 minutes to be able to feed the extra load. If it is assumed that the current drawn by the new load of 10 kW is fixed (200 A) please propose some lead-acid battery (you may look in the Internet for telecom battery manufacturers) to use considering two cases: a) you don't allow the battery voltage to drop below 5 % of the battery nominal voltage at the end of the discharge. b) you don't allow the battery voltage to fall below its minimum voltage (1.75 V/cell). For each case, estimate the battery volume using the data provided in class.

3) Suppose that you need to size an energy storage system so it can feed a 50 kW every day for an hour at a nominal voltage of 48 V. You are considering to use lead-acid batteries, li-ion batteries or ultracapacitors. Please, indicate the capacity of each energy storage option and their estimated cost so you don't expect to change any of the equipment for 5 years.

In order to answer this question, use first the information on the table in slide #4 in the class notes corresponding to week #5 and other information in the class notes before recurring to other sources.