Battery Sizing

Theoretical Concepts

Batteries are an essential part of a critical DC power system, serving as the backup power source under emergency conditions. During normal operating conditions, a DC system is generally powered by AC sources through chargers or other AC-DC interface components. However, the battery has to provide power to the system under one of the following conditions

- Load on the DC system exceeds the maximum output of the battery charger.
- Output of the battery charger is interrupted.
- Auxiliary AC power is lost.

The battery should be sized to meet the most severe of these conditions, which most likely is the third condition. When the AC power is lost, batteries will provide power to critical loads and control circuits for a specified time period so that the AC power source can be recovered or the critical equipment can be adequately shut down. For example, in U.S. nuclear power plants, it is required that batteries have sufficient capacity to supply the required load during loss of AC power for field flashing, control circuits, DC fuel oil booster pumps, and DC lube oil pumps for a period of certain no of hours. In order to meet this requirement, battery sizing calculations need to be carried out to determine the appropriate battery size.

The ETAP Battery Sizing module provides you with a powerful tool to accomplish this task. In complying with IEEE Standard 485-1997, it determines the number of strings, number of cells, and cell size of a battery for a designated duty cycle. The number of cells are determined to satisfy the maximum system voltage during the battery charging period and the minimum system voltage during the battery discharging period. The number of strings and cell size is determined to provide sufficient power to the load cycle. It also considers different factors that affect battery performance, such as design margin, aging compensation, initial capacity, and temperature, etc.

The duty cycle for the battery can be a summation of the duty cycles of all the loads that the battery is to supply power for. It can also be calculated using DC load flow, which considers different characteristics of constant power load and constant impedance load, their variations to voltage changes, branch voltage drops and losses.

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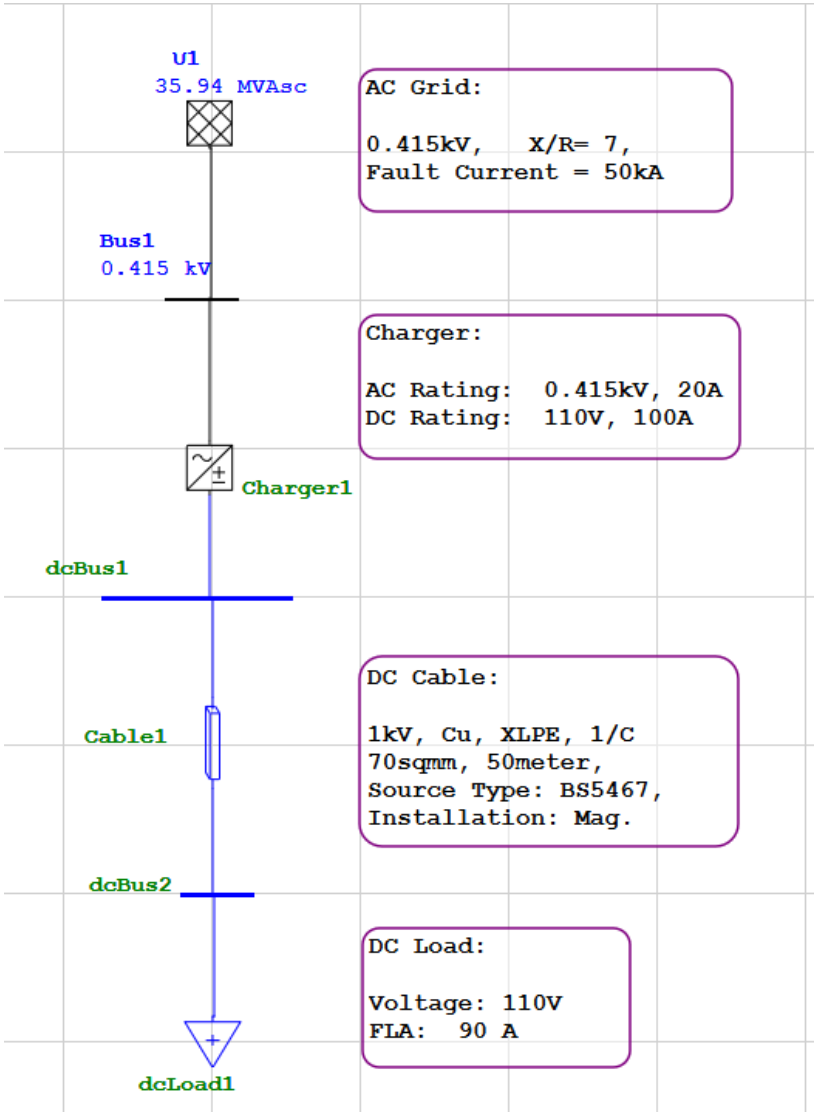
Purpose and description

The purpose of this exercise is to Size the Battery to provide power to critical loads and control circuits for a specified time period during loss of AC power.

Procedure

1. Drag and drop AC grid, Charger, DC static load, DC cable & two DC buses in OLV & connect them as shown below.



2. Double click on dcBus1 and dc bus2 & enter Nominal Voltage as 110 V.
3. Now, go to DC load flow module and run the DC Load Flow.

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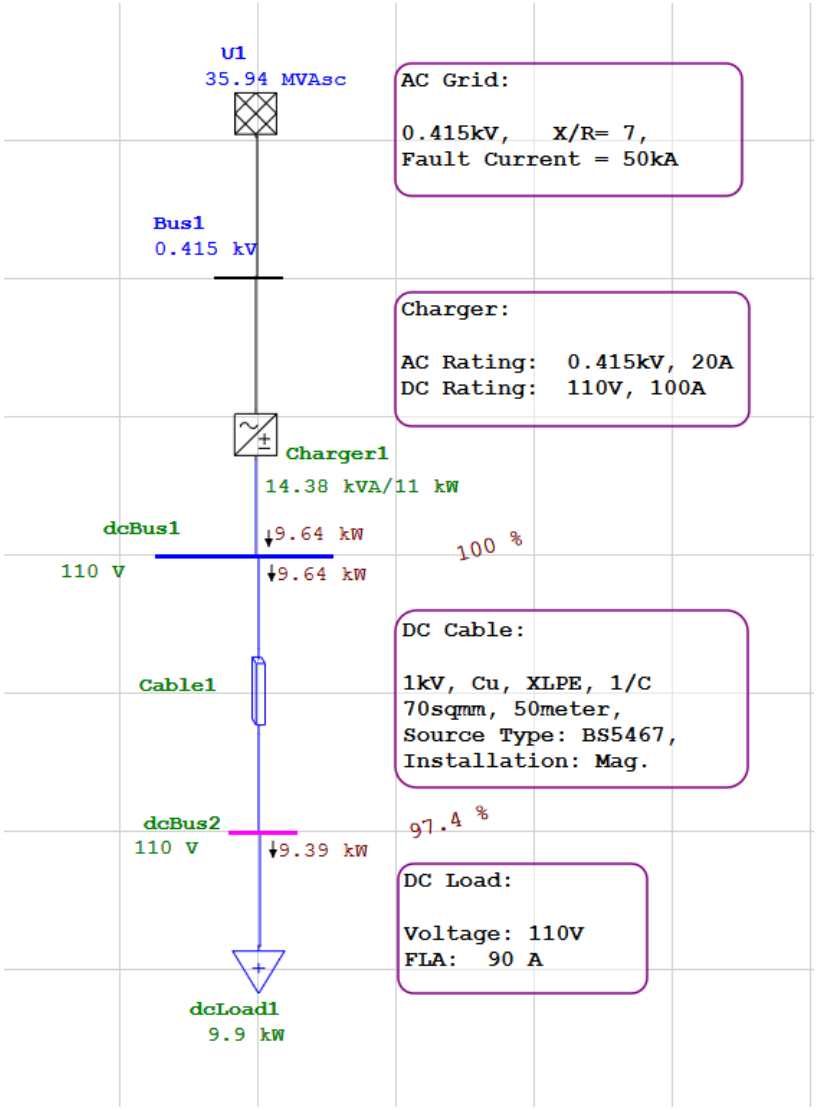

4. Add the battery at dc bus 1. Double click on Battery, go to rating page & click on library to select the following information as shown below.

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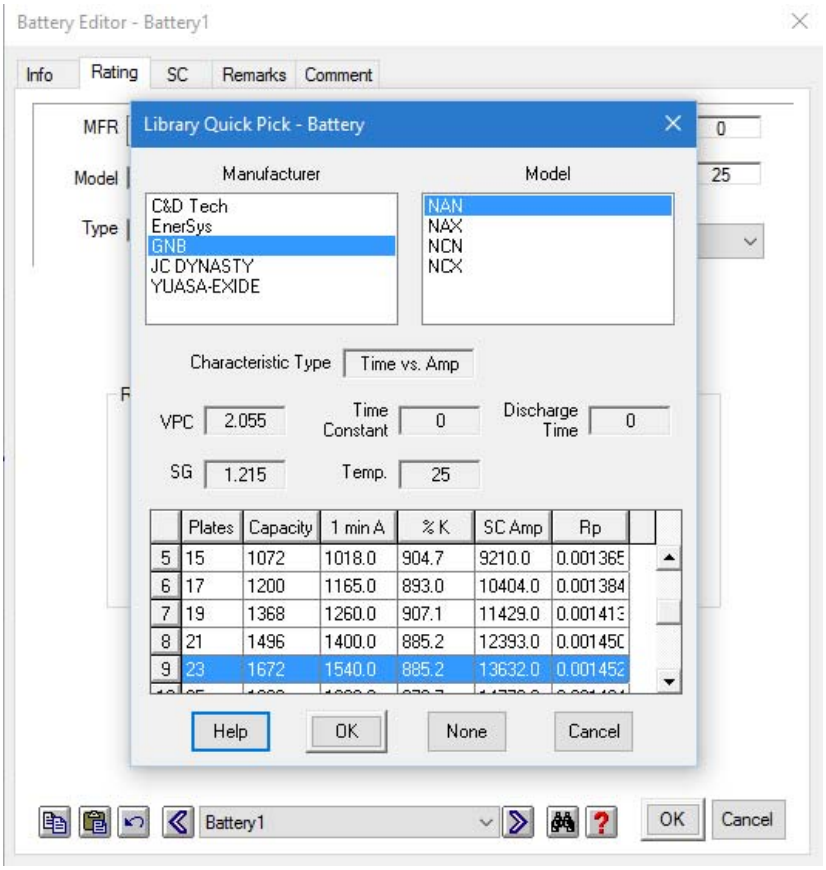
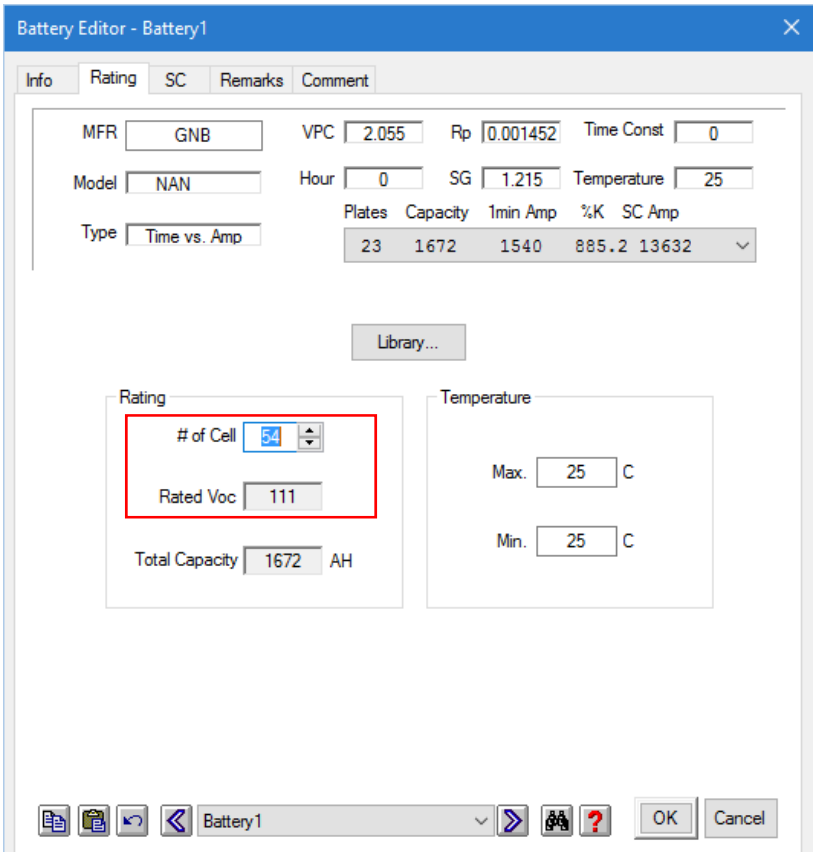


5. Increase no of Cell to get Rated Voc greater than 110 V in the Rating page of Battery.



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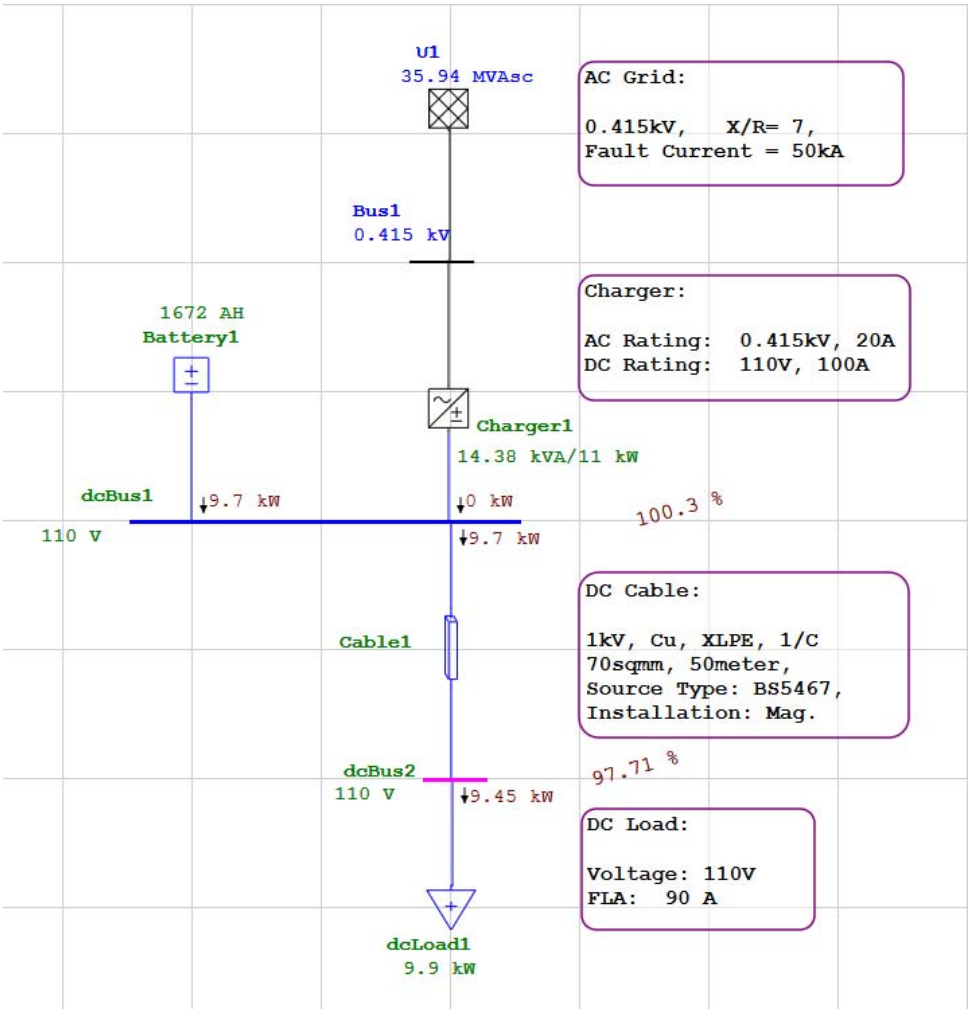
6. Run the DC load flow again.



7. Notice that, complete load requirement is supplied by battery, even though the charger is present.
8. Now increase the float voltage of charger to 105% and then run the DC load flow again.

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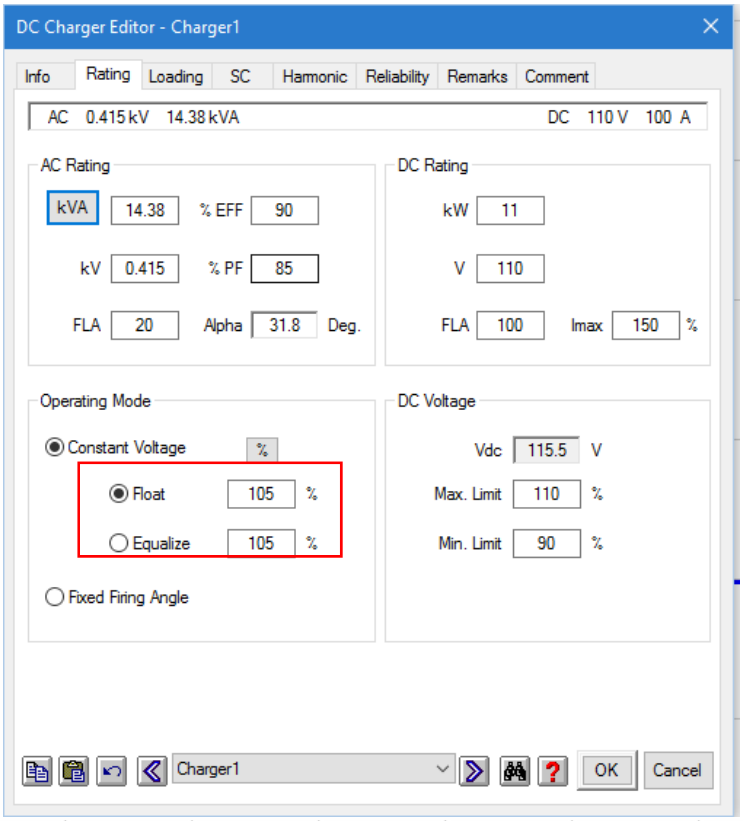

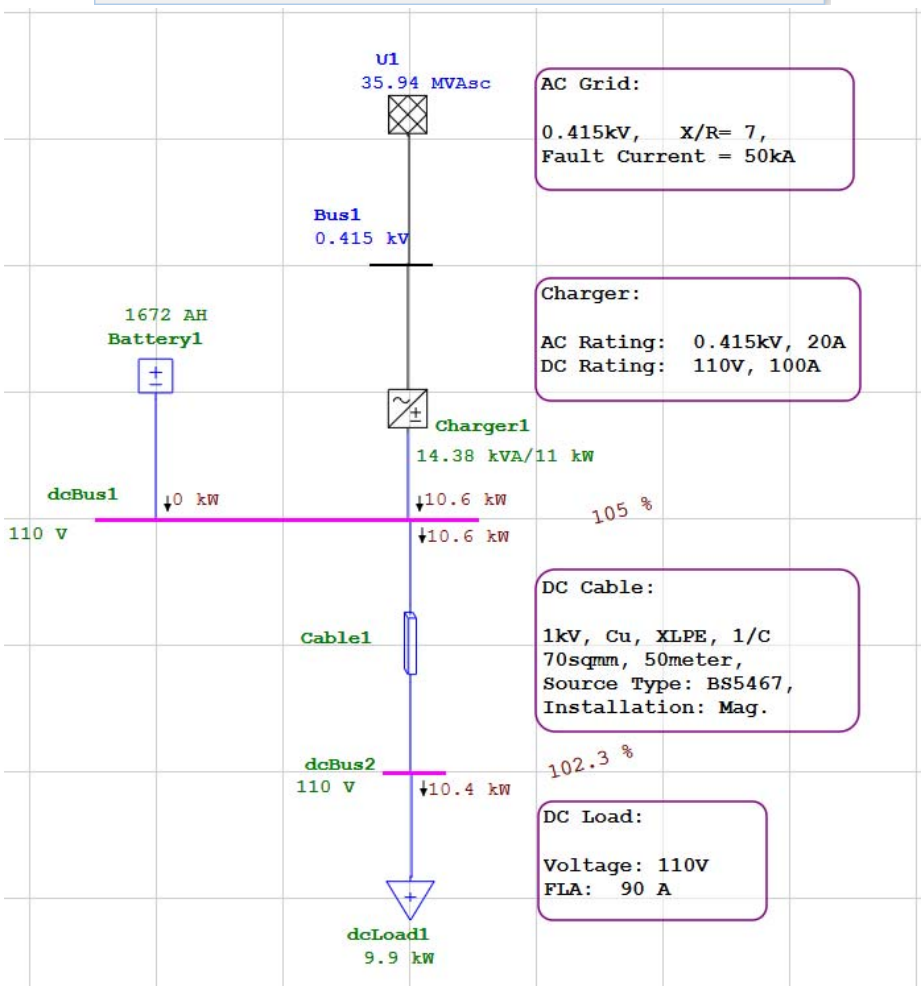

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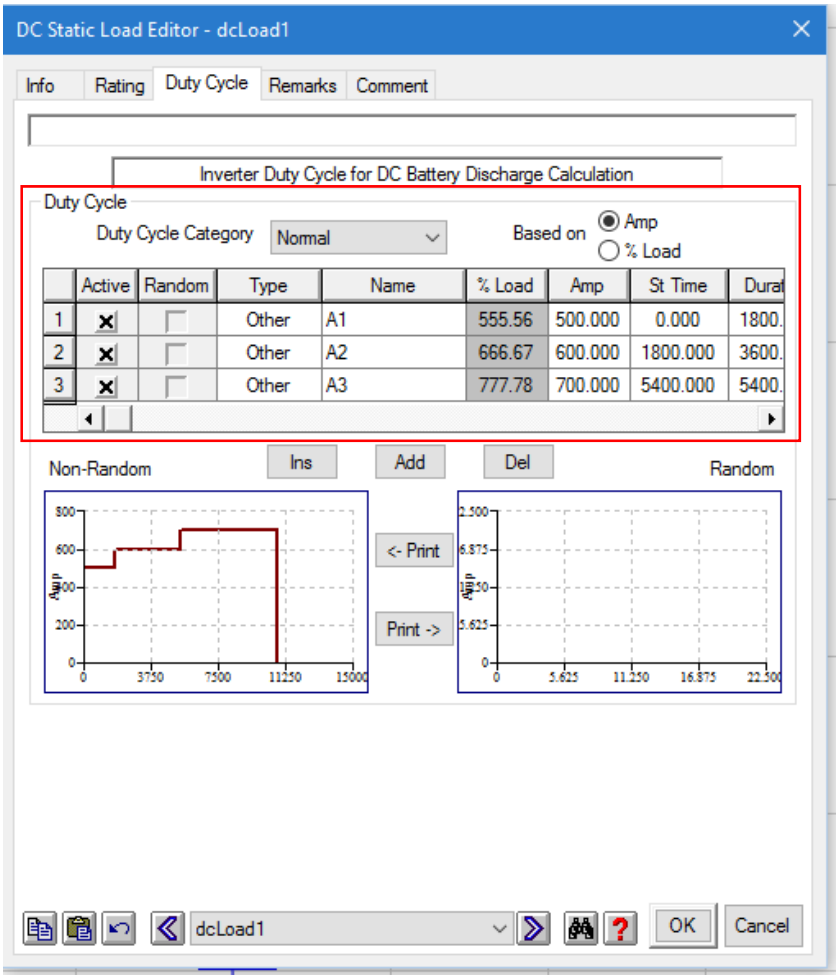
9. Notice that, complete load requirement is now supplied by battery, and not by charger.
10. Go to DC short circuit analysis module, make fault on both DC buses and run the short circuit analysis for above example. Observe the results.
11. Now, go to DC battery sizing module for finding out the correct size of battery.
12. Add load duty cycle (increasing) in DC static load, as shown below, with a Normal Duty Cycle Category.



13. Click on Battery Discharge & Sizing Module, go to Edit Study Case & select Battery1 in Battery by dropdown list.

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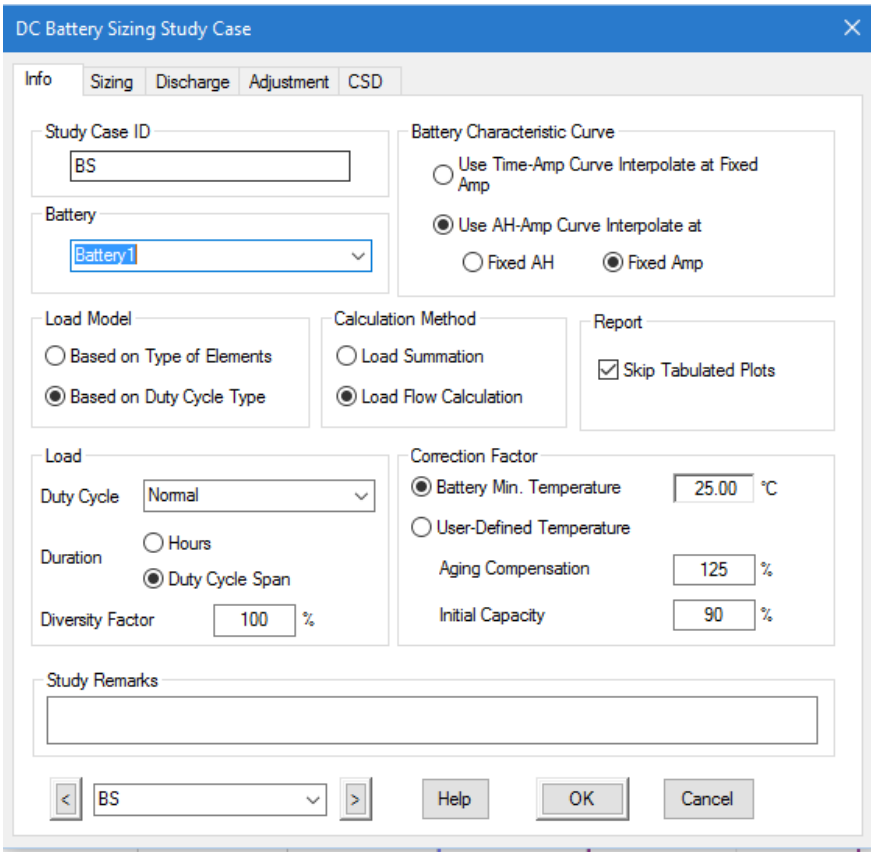
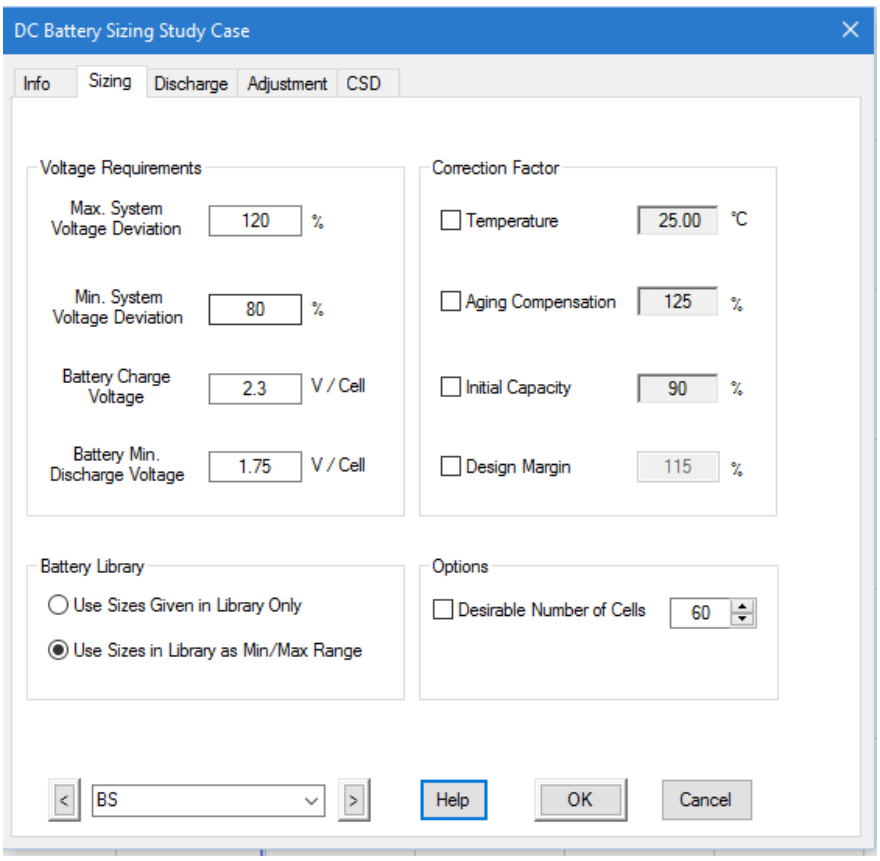


14. On sizing page unchecked all the correction factors.



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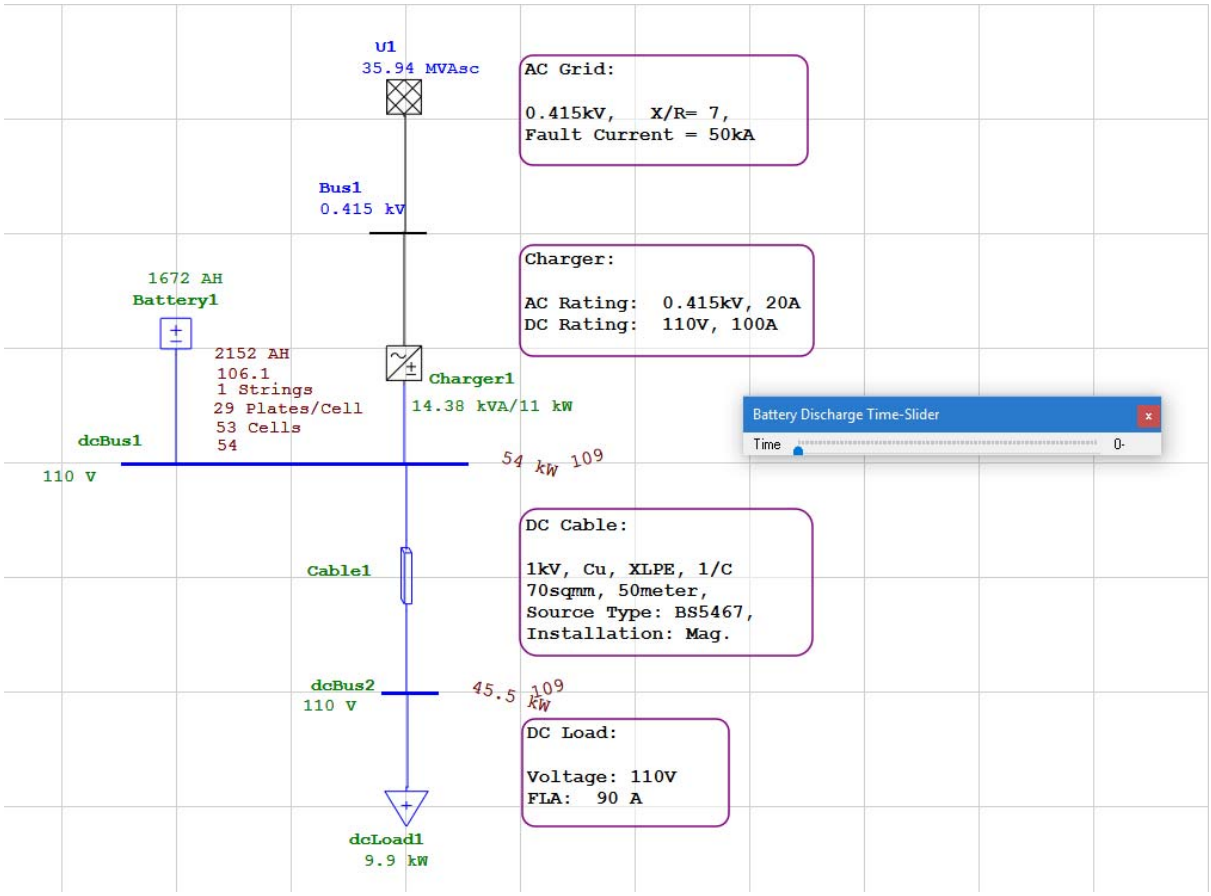
15. Run Battery Sizing & check for the results.



16. Go to Battery Discharge Plots to view Battery Voltage as shown below.