Electrical Subsystem

Q2. Battery Selection

Requirements :

- Voltage : 48V
- Avg motor current : 30A
- Peak motor current : 47A
- Additional power consumption : 150W
- Efficiency : 82%

Since we have to get 48V output from all 24 V batteries, we need to connect at least two batteries in series. Now given average current = 30A, average power consumption will be (30*48 + 150) = 1590W. Given that efficiency is 82%, required power consumption is 1590*(100/82) = 1939W.

We want our battery to run for 2 hours. For calculations, we take 20-30% error term extra to amount for different types of energy losses. So we will take required runtime as 2*1.25 = 2.5 hours.

Hence the energy required will be P*T = 2.5*1939 = 4847.5 Wh. So the capacity of the required battery pack becomes E/V = 4847.5/48 = 100.1 Ah.

Now, For 48V batteries to give 1939W output, we need I = 1939/48 = 40.4A (average current through the battery pack).

Also, I = C/Q. Upon calculating average current from this formula, we get 34.83, 38.85, 39.54, 34.33, 34.92 Ampere current respectively for the five given battery packs. Here, it is clearly observed that battery from option 3 is most appropriate as it delivers approximately the same amount of current required by our vehicle.

But simply connecting two batteries in parallel from option 3 has another problem. Our required battery pack capacity is 100.1 Ah, but we only get 61 Ah by connecting the two batteries in series (In series, battery capacity remains the same). So we have to connect a similar set of 2 batteries connected in series parallel to our original setup. In parallel, the battery capacity will add up to 61+61 = 122 Ah which will be similar as required.

Hence we need to connect four batteries such that they are connected in a setup as shown below :