### **Introduction:**

*P1:*

Good morning distinguish **clients** of ElectricGrid.

My name is Danny Wang, *[ I am Ruyun Qi]*, we are here to present to you with our proposal for the electricity supply project.

*P2:*

*[In particular, we will be addressing all your needs from the last four communications, and provide insight of our strategies in achieving the optimal values in the final three communications.]*

### **Comm 13:**

*P3:*

Based on communication 13 with your company, taking into consideration the cost for the gas generator and the accompanying 80 MWh(megawatt-hour) battery. To meet the forecast demand each day, we have proposed the following results:

*[as shown on the screen. ]*

*P4:*

As shown in the graph, since we are given with the constraint that the battery is initially empty and can be left empty at the end of the month, our model has provided the suggested electricity to be generated each day to meet the given demand. Since there is a setup cost of $300 for each order no matter how much electricity will be ordered, utilizing the battery efficiently could reduce the total cost. This can be seen in the graph where there are 19 days with no orders but using the remaining electricity in the battery to meet the demand, indicating the importance of the battery. Moreover, notice that on day 25, we are only ordering 5 MWH of electricity, which may potentially be inefficient since we will still be paying the setup fee. Thus, it may be an indication that the battery size should be reconsidered if possible.

*P5：*

Hence, our optimal total cost is $55329.57 (fifty five thousand, three hundred, twenty nine dollars).

### **Comm 14:**

*P6:*

Furthermore, considering the restrictions imposed in communication 14, since there is now a 40% chance that the demand will be higher, and the remaining 60% chance that the demand will be as previously forecast. And most importantly that we are unable to determine the demand prior to order.

*P7:*

Thus, to account for this issue, we have developed a stochastic model which produced an expected optimal value of $73593.87 (seventy three thousand, five hundred, ninety three dollars) with an initial order of 111(one hundred and eleven) MWH of electricity.

To obtain this result, we have utilised the memoization technique, which has allowed us to store all the possible outcomes and costs for the high and low demands each day. In which we are able to calculate and store the expected minimum value in a given day for different demand requirements. This process greatly reduced our calculations and has allowed us to obtain the expected optimal value.

*P8:*

Moreover, due to the stochastic nature, we are unable to obtain the actual amount to be generated each day, and as a result the cost has increased significantly, due to the probability of having higher demand requests. However, as shown in the bar graph, we have modelled the expected values of the two extreme cases of having all normal demand days and all high demand days. As illustrated in the charts, it provides the range in which the order and cost will be for a given day. which may be helpful to act as a guide for determining the order and cost in practice.

### **Comm 15:**

*P9:*

In addition, in line with our demand-reduction strategy provided in Communication 12, having the 5 days for which we can reduce the chance of high demand from 40% to 10%, has helped to further reduce the cost.

*P10:*

Hence, our model has provided an expected optimal cost of $70901.46, which has decreased the expected value by more than $2500.

*P11:*

To achieve this, we have modified our model to take into account all the possible combinations in which the days can be reduced (up to a maximum of 5 days), and utilising the same memoization technique, we are able to find the minimum expected cost. Despite it being a stochastic model, such that we are unable to obtain the actual days in which the reduction will occur. Illustrated in the graph, we have plotted the days using the battery storing the surplus electricity from all normal and all high demand days. Where it showed that the expected reduction days chosen are actually quite similar to each other, which may potentially indicate that reducing these 5 days may be beneficial. Additionally, I would also like to point out that as shown in the graph, day 22 of using the battery storing the surplus electricity of normal demand has shown an order of 0 MWH. This meant that although the day has been chosen to have its chance to be reduced we are not required to order anything and still managed to obtain the expected optimal cost. Hence having the 5 days for reducing costs has greatly reduced our expected optimal value.

### **Comm 16:**

*P12:*

Lastly, after our final communication with your company. We have carefully considered your information on the behaviour of high and normal demands, in particular if the demand is high in one day, then there is a 50% chance it will be high again the next day, while if it is normal one day then there is only a 20% chance it will be high the next day. And that requesting for demand reduction will not be affected by this behaviour.

*P13:*

Thus, we have proposed the expected optimal cost to be $65601.65. Which unsurprisingly has reduced our optimal value by another $5300 since our last proposal. This is greatly due to the demand acting in runs, which the chance of having normal demand in each day has increased. As a result this has allowed us to provide this optimal cost and an initial order of 111MWH.

*P14:*

Similar to the previous communications, we have modified our stochastic model to take in the previous demand status, and for each combination of high and normal status and reduction choice for the following days, we have stored the values which allowed us to easily find the minimum expected value.

In addition, with the unpredictable chance of high demands, as part of our strategy in achieving the optimal value, we have sampled a variety of battery sizes as shown in the graph. Which allowed us to see whether the battery size is optimal in supporting or storing the electricity in a high or normal demand day. As a last recommendation, our model showed a linear trend in the expected optimal cost vs battery size, which suggests that if it is possible to increase the size or numbers of battery, the cost will reduce linearly. In particular having 2 80MWH batteries may potentially reduce the cost by $5000.

*P15:*

Consequently, this concludes our report. Thank you for listening, hope to work with your company again.