🇬🇧 BESS charging algorithm

How do we assess liquidity availability for charging BESS in our liquidity analysis of the Slovak intraday electricity market (VDT/IDM)?

Volume check

A)Traded volumes check. In the first step, the algorithm checks whether the actual traded volume is sufficient to meet the power requirement of our battery = BESS_POWER. It monitors the maximum traded volume of the bid and ask sides = MAX_TRADED_VOLUME (if they are not equal, it means that the order was matched cross-border). If **MAX_TRADED_VOLUME >= BESS_POWER**, the check was successful and the volume is sufficient. If not, the algorithm marks the period as unsatisfactory.

B)Sell-side volumes check with the removal of planned outages. In this step, the algorithm checks whether the volume on the sell-side is sufficient to cover BESS_POWER, provided that there is no outage currently occurring on the market. In this case, we remove "outage" periods from the analysis (the specific types of outages can be found in the Outages chapter). We monitor the value of the total volume on the sell-side in the book = SALE_TOTAL_VOLUME. If **SALE_TOTAL_VOLUME >= BESS_POWER**, the check was successful and the volume is sufficient. If not, the algorithm marks the period as unsatisfactory. The number of satisfactory periods in the second step must be greater than or equal to the number of periods in step A.

C)Sell-side volumes check, including planned outages. In this step, the algorithm checks whether the sell-side volume is sufficient to cover BESS_POWER, taking into account planned outages. That is, if it is a period with a planned outage, the volume is automatically insufficient. We also monitor SALE_TOTAL_VOLUME, which we compare with the power, i.e., **SALE_TOTAL_VOLUME >= BESS_POWER**. If the check is successful, the volume is sufficient. If not, the algorithm marks the period as unsuitable. The number of satisfactory periods in the third step must be less than or equal to the number of periods in step B.

BESS simulation for providing aFRR+

From the first part of the algorithm, we are able to use the checked liquid periods to assess the possibility of charging the BESS during the period. Here, we simulate the operation of the battery storage during the monitored period, in the event that it provides ancillary services (aFRR+) and continuously attempts to recharge from the market step by step. In this simulation, we use the logic from Step B) (Sell-side volumes check with the removal of planned outages) or C) (Sell-side volumes check, including planned outages) when buying from the market.

Before running the algorithm, we first calculate the most conservative scenario for providing aFRR+. We weigh each 15-minute period by the number of 4-second periods (900 in total) during which, according to PICASSO, the aFRR+ service was activated for Slovakia within that 15-minute period. Based on the power we provide for aFRR+, we then calculate how much energy we have spent on aFRR+ in 15 minutes. For example, if we provide 1 MW of power and aFRR+ was activated 440 times out of 900 during the period, the energy discharged for the ancillary service during 15 minutes was: 440/900*1 MW*15 min/60 min = 0.12 MWh. We will use this conservative scenario for providing ancillary services in the algorithm for simulating BESS for aFRR+.

Step by step, the algorithm goes through each 15-minute period as follows:

1. **Update the battery state-of-charge (SOC)**
    a. Take the previous battery level from t-15min.
    b. Subtract the energy used for the aFRR+ ancillary service (discharge) after taking losses into account.
    c. Add the energy purchased from the market if possible (recharge) after taking losses into account.
    d. the result is the new SoC for t.
2. **Decision on whether to purchase energy**
    a. We add the updated charge level at time t to the purchases already entered at times t+15min, t+30min, and t+45min and the maximum energy we can supply to the battery in 15 minutes (BESS_POWER).
    b. If this sum is lower than the maximum capacity of the BESS, we place an order at time t+60min in the amount of BESS_POWER (the order will not be executed if there is no liquidity on the market/if there is an outage).
    c. If condition b is not met, at time t+60min, we will only purchase the volume that we would discharge due to providing aFRR+ at time t.
3. **BESS failure marking**
    a. If SOC falls below 0, the algorithm will mark this period in the graph.
    b. In this case, the SOC will not "restart" so that it is possible to see how many periods the BESS needs to return to feasible values.

In this way, we try to simulate the behaviour of the battery storage in real market conditions in the most conservative scenario possible, period by period.

Interesting dates

For example, on November 5, 2024, when available liquidity increased dramatically. Similarly, on January 1, 2025, when, even without a planned outage, market liquidity was very low, and the state of charge of batteries reached its minimum. June 10, 202,5 nicely illustrates the adaptability of BESS immediately after the outage was removed. Similarly, December 9 to 11, 2024 (BESS has no problem with SOC even with two short successive outages). September 6, 2025, is an interesting day when we have no outages, but on the other hand, no liquidity on OKTE and no activation of aFRR+. Many of the isolated no-trade periods are also accompanied by low aFRR activation during this period. Liquidity increases with the monitored period.

Outages

By outages, we mean planned outages, i.e., outages that are known at least one day in advance. In step B), we simply delete such periods from the analysis, and in step C), we consider them to be unsuitable periods. In the case of unplanned outages (outages where the notification date is the same as the outage date), we look at the traded/available volume on the market and decide whether it is possible to charge for the given period. We consider the following outages in the analysis:

- Shutdowns from the Excel file requested from OKTE in accordance with the Information Act,
- Outages from OKTE with the heading: “VDT: (XBID_NEMO_07): Údržba systémov XBID | IDM: Maintenance on XBID System”,
- Outages from OKTE with the heading: “VDT: (XBID_NEMO_24): Zmeny konfigurácie s dopadom na systémy XBID | IDM: (XBID_NEMO_24): Configuration change with impact on the XBID System”.

Outages with other ids are unplanned (announced on the day of the outage) and are therefore evaluated on an individual basis according to the traded/available volume in the given period.

Contact

If you have any questions, please feel free to contact us:

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