

## Short Term Operating Reserve (STOR) Assessment Principles

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## Introduction

This document sets out the principles that National Grid Electricity System Operator (NGESO) considers in assessing day ahead bids for Short Term Operating Reserve (STOR). It builds on the assessment principles which have historically been published by NGESO for the purposes of the STOR assessment under the Standard Contract Terms (SCTs).

NGESO may update these principles from time to time by publication of an updated version on its website, and to the extent required by the Electricity Balancing Guidelines, any variation will be proposed and implemented in accordance with the applicable requirements in the Electricity Balancing Guidelines.

These STOR Service Terms are to be read alongside the STOR Auction Rules, and are subject to the prevailing STOR General Terms and Conditions published by NGESO.

Unless the context otherwise requires, any capitalised term used in this document shall have the meaning given to it (if any) in the prevailing STOR Glossary of Terms and Rules of Interpretation, and the rules of interpretation set out in that document shall also apply.

## Prequalification criteria

When undertaking assessment of STOR Bids, NGESO assumes that each STOR Bid has been submitted by or on behalf of an entity with an active registration as a Registered STOR Participant, and that the relevant Plant and Apparatus has been validated by NGESO as an Eligible Asset, and properly allocated to the relevant STOR Unit, and that the STOR Unit has been registered with approved Technical Parameters.

Where NGESO deems a STOR Bid to be non-compliant then the Registered STOR Participant will be notified and the STOR Bid will not be assessed in the relevant auction.

## Assessment principles

NGESO's objective is to operate the transmission system economically, and the assessment is made consistent with that. A STOR Bid with respect to a STOR Unit will be accepted only where NGESO believes that the total costs of securing and operating the system are lower with, than without a corresponding STOR Contract from that STOR Unit.

## Reserve

STOR is procured to meet some of our reserve requirement through balancing services when it is economic to do so. This requirement is to provide additional energy in megawatts (MW) in short timescales.

Reserve is needed for frequency management when there is an imbalance between supply of energy and demand for energy. When the instantaneous supply is not enough to meet the demand, the frequency falls and extra energy is needed very quickly to re-establish this balance. This can be supplied by additional generation or demand reduction. Initially this is provided by frequency response which initiates automatically. Response is only maintained for a maximum of 30 minutes. Reserve is then instructed within 2-30 minutes in order to replace the frequency response.

## STOR Bids

STOR will continue to be procured across STOR Windows, comprising committed (and optional) windows spread across an entire operational day (05.00 to 05.00), but for day ahead STOR procurement NGESO will only run auctions for the committed windows in a *single* operational day.

The STOR Windows, which vary depending on the time of year (Season) and working/non-working days, are published on the NGESO website alongside the new suite of contract documents. These are reviewed and updated by NGESO on an annual basis, as described on the NGESO website.

Each STOR Bid will represent a single offered MW capability, and accompanying price (£/MW/h), for each of the committed windows in an operational day. A STOR Bid must include the same price for each committed window. And it is not possible to submit a STOR Bid for only one of the committed windows in the day.

The price associated with the marginal accepted STOR Unit sets the availability (clearing) price for all accepted STOR Bids for the operational day in question (see further below).

More details are provided in the STOR Participation Guidance Document and the STOR Auction Rules.

## The alternative cost: the buy curve

The buy curve is the assumed cost to NGESO of procuring STOR in the committed windows in an operational day, by creating short term operating reserve within day as an alternative to running a day ahead auction. This alternative cost will create an availability price cap by showing NGESO's willingness to pay for securing short term operating reserve capacity.

This will be calculated using:

- the volume of actions (MW) required to create the reserve needed, and
- the prices (£/MWh) available to NGESO to access that volume.

A separate buy curve is calculated for each operational day and therefore each auction, using the prevailing STOR requirement volume (currently 1,700MW but as notified by NGESO from time to time). NGESO will endeavour to publish the buy curve for each auction alongside the STOR Daily Report.

## Assessment Methodology

The assessment methodology for acceptance of STOR Bids, and establishment of the clearing price, is based on the following key parameters:-

Buy curve – this is produced for each operational day, as explained above.

Supply curve – this is the aggregate MW represented by all STOR Bids received by NGESO for the operational day, sorted from lowest availability price to highest availability price.

Marginal bid – this is the STOR Bid that makes the supply curve cross the buy curve. Any further STOR Bids in the supply curve are above the alternative cost. If this marginal bid causes overholding (ie total procured STOR would exceed the STOR requirement for that day) and cannot be curtailed, then it will need to be rejected. There could be more than one marginal bid when there is more than one STOR Bid at the same price and this is the marginal bid.

All compliant STOR Bids received by the STOR Bid Deadline will be assessed in the same way using the following criteria:

- Each STOR Bid will comprise an availability price (£/MW/hr) and megawatt (MW) capacity
- STOR Bids are sorted from lowest to highest availability price
- NGESO determines if the marginal bid can be accepted based on the buy curve
  - If it can then NGESO will accept the marginal bid
  - If not, then NGESO will reject the marginal bid (and therefore remove it from the supply curve) and assess the new marginal bid
  - This is repeated until the marginal bid is found.

The marginal bid's price sets the clearing price and all participants with accepted STOR Bids for the day in question receive that price for their volume.

This auction will not allow overholding to be caused as this is when additional volume over the requirement is procured. This is in line with our other procured services for response.

In the event that the marginal bid(s) would cause overholding, the curtailability ratio of each such marginal bid will be calculated as follows:

$$\text{Curtailability ratio} = \text{minimum acceptance capacity MW} / \text{Tendered MW}$$

The marginal bid that has the lowest curtailability ratio will be accepted at the lower of the remaining requirement or the offered MW capability.

In the event that there is more than one marginal bid with the same curtailability ratio, then a last resort rank will be used.

The last resort rank is applied to all STOR Bids in the auction, and will be used to separate two or more STOR Bids that are completely identical and cannot both/all be accepted without causing overholding.

## Examples (all prices and volumes are illustrative only)

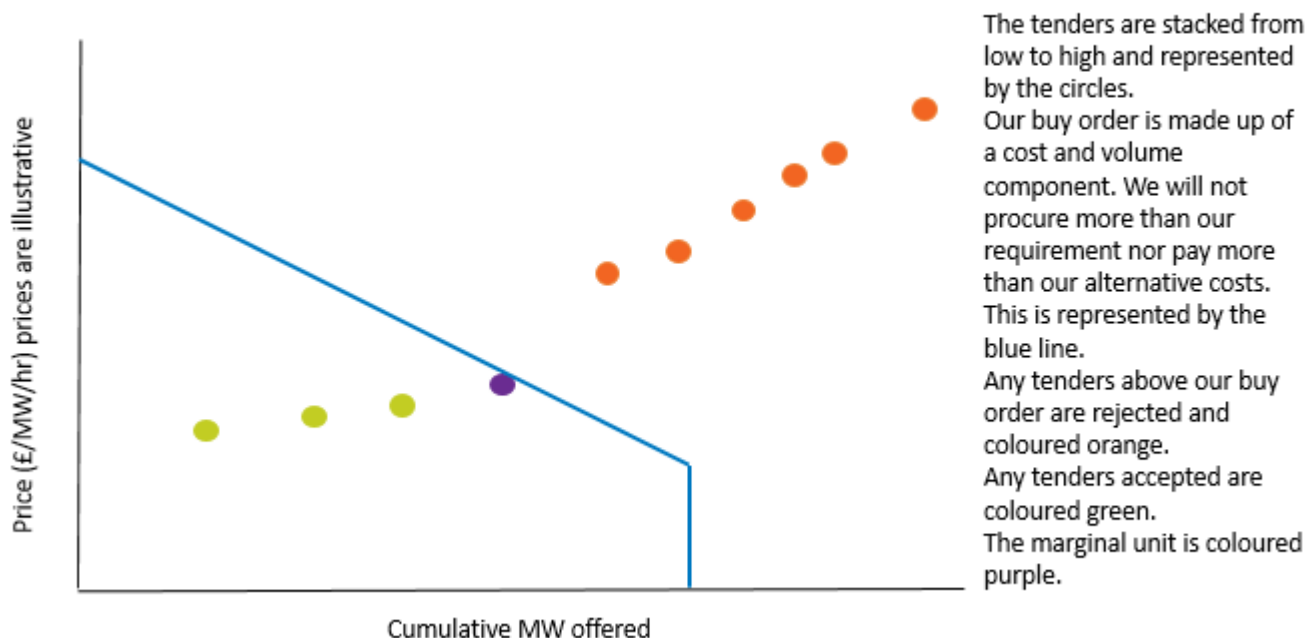
### Example 1

There is one marginal bid (tender 4 in bold box).

It can be accepted without causing overholding so is accepted.

All other STOR Bids are more expensive than alternative actions so are rejected.

|                 | Tendered MW | Minimum acceptance capacity MW | Curtailability ratio | Price    | Accepted MW | Cumulative accepted MW | Remaining requirement | Accept/Reject   |
|-----------------|-------------|--------------------------------|----------------------|----------|-------------|------------------------|-----------------------|-----------------|
|                 |             |                                |                      |          |             |                        | 320                   |                 |
| Tender 1        | 30          | 20                             | 0.67                 | 5        | 30          | 30                     | 290                   | Accepted        |
| Tender 2        | 40          | 25                             | 0.63                 | 5.3      | 40          | 70                     | 250                   | Accepted        |
| Tender 3        | 25          | 20                             | 0.80                 | 5.8      | 25          | 95                     | 225                   | Accepted        |
| <b>Tender 4</b> | <b>60</b>   | <b>30</b>                      | <b>0.50</b>          | <b>6</b> | <b>60</b>   | <b>155</b>             | <b>165</b>            | <b>Accepted</b> |
| Tender 5        | 50          | 30                             | 0.60                 | 8        | 0           | 155                    | 165                   | Rejected        |
| Tender 6        | 60          | 50                             | 0.83                 | 9        | 0           | 155                    | 165                   | Rejected        |
| Tender 7        | 80          | 30                             | 0.38                 | 10       | 0           | 155                    | 165                   | Rejected        |
| Tender 8        | 55          | 20                             | 0.36                 | 10       | 0           | 155                    | 165                   | Rejected        |
| Tender 9        | 60          | 15                             | 0.25                 | 12       | 0           | 155                    | 165                   | Rejected        |
| Tender 10       | 120         | 80                             | 0.67                 | 15       | 0           | 155                    | 165                   | Rejected        |



### Example 2

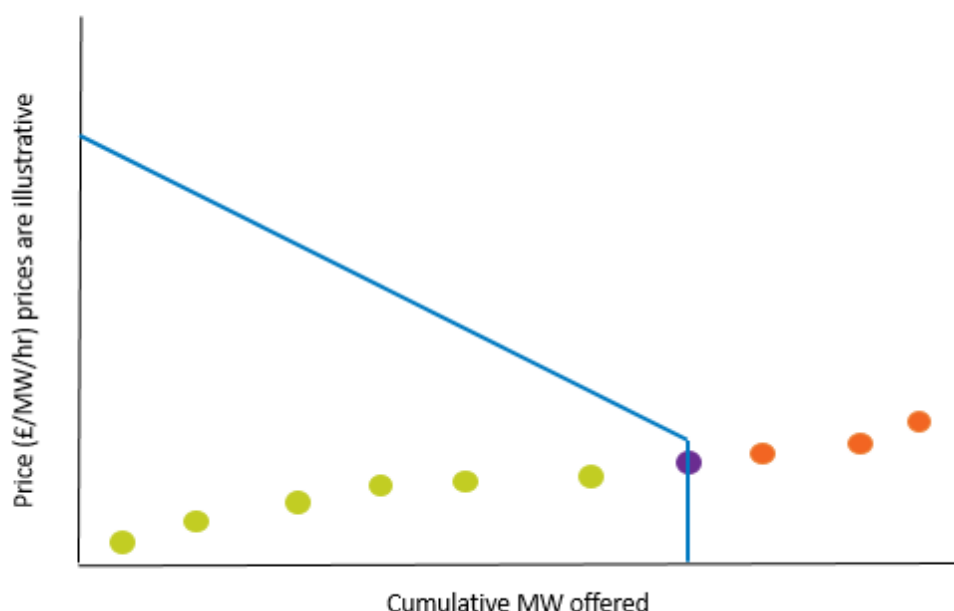
There is one marginal bid (tender 7 in bold box)

This STOR Bid cannot be accepted without causing overholding but can be curtailed.

This STOR Bid is curtailed to 55MW which is the remaining requirement and the unit is accepted.

All other STOR Bids are rejected as the requirement has been met by more economic actions.

|           | Tendered MW | Minimum acceptance capacity MW | Curtailability ratio | Price | Accepted MW | Cumulative accepted MW | Remaining requirement | Accept/Reject |
|-----------|-------------|--------------------------------|----------------------|-------|-------------|------------------------|-----------------------|---------------|
|           |             |                                |                      |       |             |                        | 320                   |               |
| Tender 1  | 30          | 20                             | 0.67                 | 2.5   | 30          | 30                     | 290                   | Accepted      |
| Tender 2  | 40          | 25                             | 0.63                 | 2.7   | 40          | 70                     | 250                   | Accepted      |
| Tender 3  | 25          | 20                             | 0.80                 | 2.8   | 25          | 95                     | 225                   | Accepted      |
| Tender 4  | 60          | 30                             | 0.50                 | 2.9   | 60          | 155                    | 165                   | Accepted      |
| Tender 5  | 50          | 30                             | 0.60                 | 3     | 50          | 205                    | 115                   | Accepted      |
| Tender 6  | 60          | 50                             | 0.83                 | 3.2   | 60          | 265                    | 55                    | Accepted      |
| Tender 7  | 80          | 30                             | 0.38                 | 3.3   | 55          | 320                    | 0                     | Accepted      |
| Tender 8  | 55          | 20                             | 0.36                 | 5     | 0           | 320                    | 0                     | Rejected      |
| Tender 9  | 60          | 15                             | 0.25                 | 6     | 0           | 320                    | 0                     | Rejected      |
| Tender 10 | 120         | 80                             | 0.67                 | 7     | 0           | 320                    | 0                     | Rejected      |



The tenders are stacked from low to high and represented by the circles.

Our buy order is made up of a cost and volume component. We will not procure more than our requirement nor pay more than our alternative costs. This is represented by the blue line.

Any tenders above our buy order are rejected and coloured orange.

Any tenders accepted are coloured green.

The marginal unit is coloured purple and here cannot be fully accepted without causing overholding. If this unit can be curtailed, it will be. If it cannot be curtailed it will be rejected.

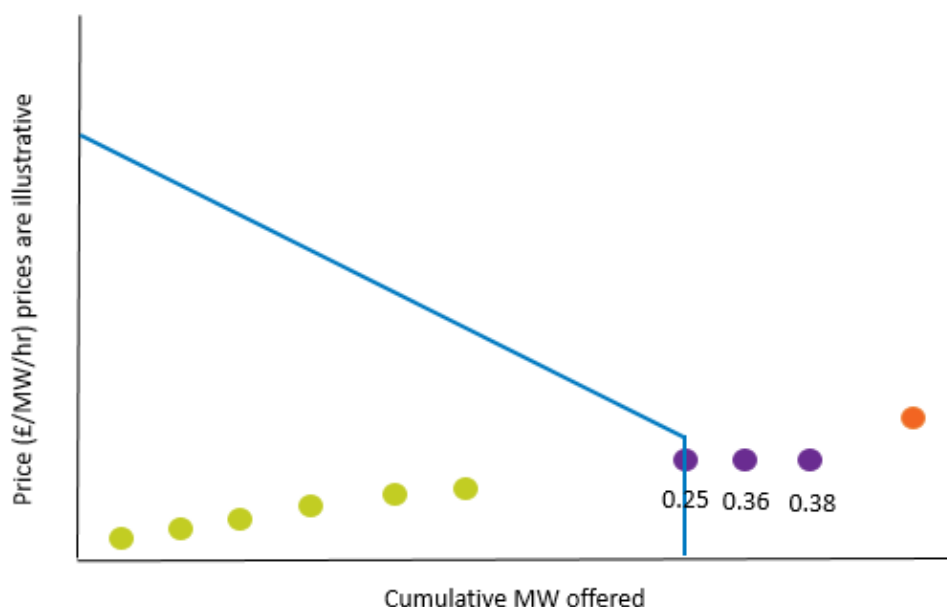
### Example 3

Where there are multiple STOR Bids at the marginal price all cannot be accepted without causing overholding.

STOR Bids affected (only those at the marginal price) will be ordered on their curtailability ratio from low to high. (Shown by the darker box)

The STOR Bid with the lowest curtailability ratio is accepted for the lower of the remaining requirement or offered MW capability.

|           | Tendered MW | Minimum acceptance capacity MW | Curtailability ratio | Price | Accepted MW | Cumulative accepted MW | Remaining requirement | Accept/Reject |
|-----------|-------------|--------------------------------|----------------------|-------|-------------|------------------------|-----------------------|---------------|
|           |             |                                |                      |       |             |                        | 320                   |               |
| Tender 1  | 30          | 20                             | 0.67                 | 2.5   | 30          | 30                     | 290                   | Accepted      |
| Tender 2  | 40          | 25                             | 0.63                 | 2.7   | 40          | 70                     | 250                   | Accepted      |
| Tender 3  | 25          | 20                             | 0.80                 | 2.7   | 25          | 95                     | 225                   | Accepted      |
| Tender 4  | 60          | 30                             | 0.50                 | 2.9   | 60          | 155                    | 165                   | Accepted      |
| Tender 5  | 50          | 30                             | 0.60                 | 3     | 50          | 205                    | 115                   | Accepted      |
| Tender 6  | 60          | 50                             | 0.83                 | 3.1   | 60          | 265                    | 55                    | Accepted      |
| Tender 9  | 60          | 15                             | 0.25                 | 3.2   | 55          | 320                    | 0                     | Accepted      |
| Tender 7  | 55          | 20                             | 0.36                 | 3.2   | 0           | 320                    | 0                     | Rejected      |
| Tender 8  | 80          | 30                             | 0.38                 | 3.2   | 0           | 320                    | 0                     | Rejected      |
| Tender 10 | 120         | 80                             | 0.67                 | 4.4   | 0           | 320                    | 0                     | Rejected      |



The tenders are stacked from low to high and represented by the circles. Our buy order is represented by the blue line. Any tenders above our buy order are rejected and coloured orange. Any tenders accepted are coloured green. Here there are three marginal units (purple) with the same price. All of these tenders cannot be accepted without causing overholding. The unit with highest curtailability ratio will be accepted first, if it can be accepted without causing overholding.

#### Example 4

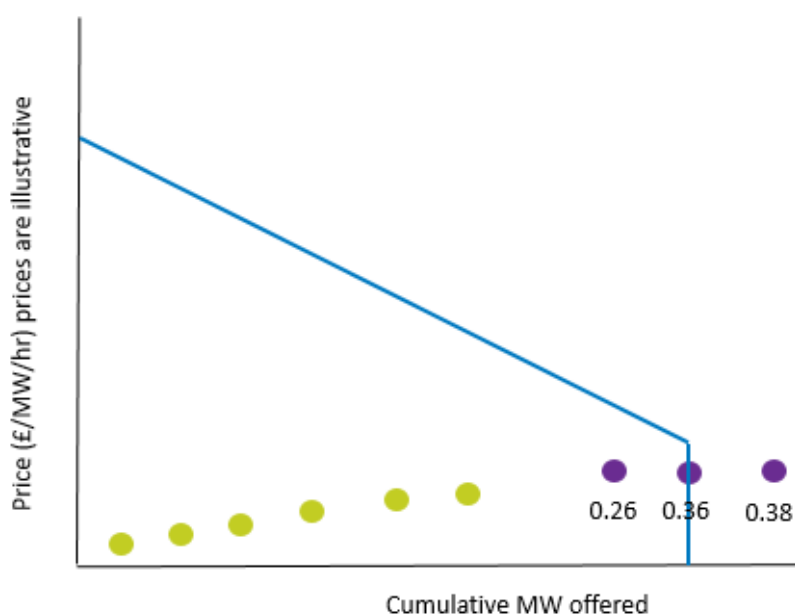
Where there are multiple STOR Bids at the marginal price all cannot be accepted without causing overholding.

STOR Bids affected (only those at the marginal price) will be ordered on their curtailability ratio from low to high. (Shown by the darker box)

The STOR Bid with the lowest curtailability ratio is accepted for the lower of the remaining requirement or offered MW capability.

If there is any remaining requirement the next lowest curtailability ratio is accepted if there is sufficient remaining requirement to not cause overholding.

|           | Tendered MW | Minimum acceptance capacity MW | Curtailability ratio | Price | Accepted MW | Cumulative accepted MW | Remaining requirement | Accept/Reject |
|-----------|-------------|--------------------------------|----------------------|-------|-------------|------------------------|-----------------------|---------------|
|           |             |                                |                      |       |             |                        | 320                   |               |
| Tender 1  | 30          | 20                             | 0.67                 | 2.5   | 30          | 30                     | 290                   | Accepted      |
| Tender 2  | 40          | 25                             | 0.63                 | 2.7   | 40          | 70                     | 250                   | Accepted      |
| Tender 3  | 25          | 20                             | 0.80                 | 2.7   | 25          | 95                     | 225                   | Accepted      |
| Tender 4  | 60          | 30                             | 0.50                 | 2.9   | 60          | 155                    | 165                   | Accepted      |
| Tender 5  | 50          | 30                             | 0.60                 | 3     | 50          | 205                    | 115                   | Accepted      |
| Tender 6  | 60          | 50                             | 0.83                 | 3.1   | 60          | 265                    | 55                    | Accepted      |
| Tender 9  | 35          | 9                              | 0.26                 | 3.2   | 35          | 300                    | 20                    | Accepted      |
| Tender 7  | 55          | 20                             | 0.36                 | 3.2   | 20          | 320                    | 0                     | Accepted      |
| Tender 8  | 80          | 30                             | 0.38                 | 3.2   | 0           | 320                    | 0                     | Rejected      |
| Tender 10 | 120         | 80                             | 0.67                 | 4.4   | 0           | 320                    | 0                     | Rejected      |



The tenders are stacked from low to high and represented by the circles.

Our buy order is represented by the blue line.

Any tenders above our buy order are rejected and coloured orange.

Any tenders accepted are coloured green.

Here there are three marginal units (purple) with the same price. All of these tenders cannot be accepted without causing overholding.

The unit with highest curtailability ratio will be accepted first, if it can be accepted without causing overholding.

### Example 5

Where there are multiple identical STOR Bids at the same marginal price that cannot all be accepted without causing overholding.

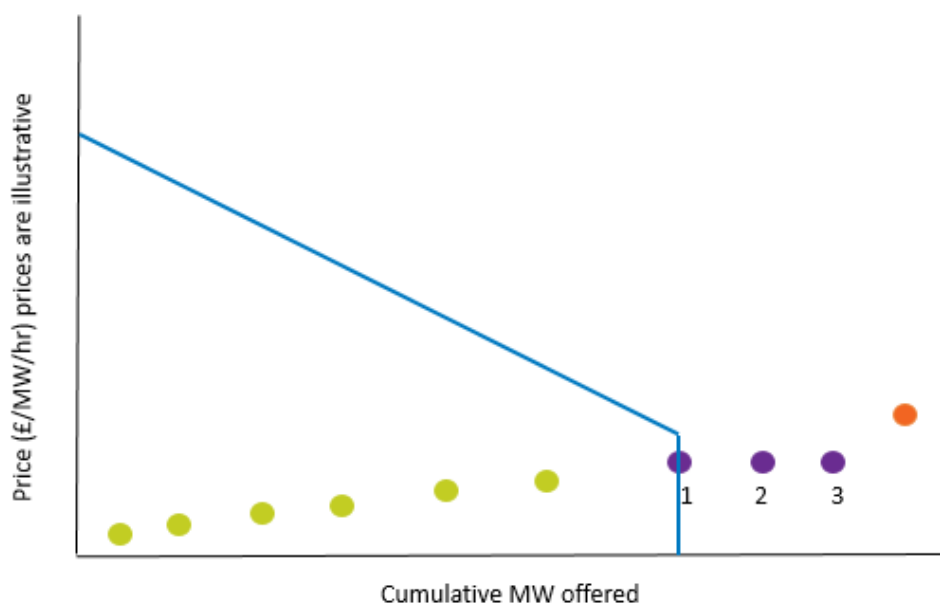
The marginal units are ordered by the last resort rank.

STOR Bids are accepted in this order for the lower of the remaining requirement or their offered MW capability.

Any remaining requirement is awarded to the marginally priced STOR Bid with the highest last resort rank (shown in green).



|           | Tendered MW | Minimum acceptance capacity MW | Curtailability ratio | Price | Last resort rank | Accepted MW | Cumulative accepted MW | Remaining requirement |
|-----------|-------------|--------------------------------|----------------------|-------|------------------|-------------|------------------------|-----------------------|
|           |             |                                |                      |       |                  |             |                        | 320                   |
| Tender 1  | 30          | 20                             | 0.67                 | 2.5   |                  | 30          | 30                     | 290                   |
| Tender 2  | 40          | 25                             | 0.63                 | 2.7   |                  | 40          | 70                     | 250                   |
| Tender 3  | 25          | 20                             | 0.80                 | 2.8   |                  | 25          | 95                     | 225                   |
| Tender 4  | 60          | 30                             | 0.50                 | 2.9   |                  | 60          | 155                    | 165                   |
| Tender 5  | 50          | 30                             | 0.60                 | 3     |                  | 50          | 205                    | 115                   |
| Tender 6  | 60          | 50                             | 0.83                 | 3.2   |                  | 60          | 265                    | 55                    |
| Tender 9  | 80          | 44                             | 0.55                 | 3.3   | 1                | 55          | 320                    | 0                     |
| Tender 7  | 55          | 30                             | 0.55                 | 3.3   | 2                | 0           | 320                    | 0                     |
| Tender 8  | 31          | 17                             | 0.55                 | 3.3   | 3                | 0           | 320                    | 0                     |
| Tender 10 | 120         | 80                             | 0.67                 | 7     |                  | 0           | 320                    | 0                     |



The tenders are stacked from low to high and represented by the circles. Our buy order is represented by the blue line. Any tenders above our buy order are rejected and coloured orange. Any tenders accepted are coloured green. Here there are three marginal units (purple) with the same price. All of these tenders cannot be accepted without causing overholding. These units all have the same curtailability ratio so will use the last resort rank low to high.