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P217 Definition Report – Attachment 1 - Balancing Services Adjustment Data (BSAD) Methodology

This paper seeks to provide a simple description of Balancing Services Adjustment Data (BSAD) and using examples, show how it is treated within the BSC cashout arrangements (i.e. for settlement of imbalances).

BSAD is calculated in accordance with the BSAD Methodology Statement[1] which is required under National Grid's Transmission Licence.

BSAD is determined from transactions that are undertaken external to the Balancing Mechanism. It is intended to reflect payment amounts associated with balancing but which are not included in bid/offer acceptances. These include Pre Gate Closure Balancing Trades (PGBT), the availability component of BM start-up, System Operator (SO) to SO transactions, the option component of Short Term Operating Reserve (STOR), energy trading on APX (or brokers) and locational trades.

In accordance with the BSAD Methodology Statement, National Grid is required to determine each non-BM transaction as either a 'system' or 'energy' action. 'System' actions include any action taken to alleviate a Transmission constraint[2], and any SO to SO transactions taken to manage the rate at which load flow on the interconnectors that connect to the GB transmission system change. Such actions are considered to be 'system' regardless of whether they also assist in balancing energy. 'Energy' actions are those that are not considered to have any 'system' requirement component, including procurement of reserve to create margin and buying and selling of energy by the SO.

There are 8 BSAD variables that are calculated for the purposes of BSAD. These are shown in table 1.

Table 1 BSAD variables

System Buy Price Volume Adjustment (SBVA)	SBVA and SSVA can be considered a pair. The volumes are netted in each Settlement Period so that only one is non-zero and enters the Energy Imbalance Price calculation[3].
System Sell Price Volume adjustment (SSVA)	
Energy Buy Price Volume Adjustment (EBVA)	EBVA and ESVA can be considered a pair. The volumes are netted in each Settlement Period so that only one is non-zero and enters the Energy Imbalance Price calculation.
Energy Sell Price Volume Adjustment (ESVA)	
Energy Buy Price Cost Adjustment (EBCA)	EBCA and ESCA relate to EBVA and ESVA respectively. EBCA is zero if EBVA is zero. ESCA is zero if ESVA is zero.
Energy Sell Price Cost Adjustment (ESCA)	
Buy Price Adjuster (BPA)	BPA is added to the main Energy Imbalance Price if the system is short. SPA is added if the system is long.
Sell Price Adjuster (SPA)	

[1] This can be found on National Grid's website here: http://www.nationalgrid.com/NR/rdonlyres/F0122F70-41A3-449B-9322-047986A8C312/12144/BSADv33AppxCFinal.pdf
[2] This can be a thermal, voltage or stability transmission constraint.
[3] Note that this netting would not occur under the Modification Group's principle of disaggregating BSAD.

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The following information contributes to the calculation of the main Energy Imbalance Price:

- Actions taken within the Balancing Mechanism to increase the total energy on the system (Accepted Offers), or actions within the Balancing Mechanism to decrease the total energy on the system (Accepted Bids); and
- Relevant Balancing Services provided outside the Balancing Mechanism, represented via BSAD

These Accepted Offers and Accepted Bids are ranked in price order in two separate stacks – the total volume of which gives a gross imbalance volume. BSAD is then added to one of these stacks. The stacks are then subject to the application of the current set of tagging rules[4]. Of the tagging rules, Net Imbalance Volume (NIV) tagging is where the smaller (in terms of MWh) of the bid stack and offer stack, is removed from the other.

For each Settlement Period, the main Energy Imbalance Price will include three of the BSAD components included in table 1:

1. A system volume (SBVA or SSVA) that enters the stack of actions to be considered in determining the NIV;
2. An energy volume with an associated energy cash flow (EBVA and EBCA or ESVA and ESCA) that enter the 'stack' of actions to be considered in pricing as one priced volume (See example below); and
3. A price adjustment (BPA or SPA) that is added to the main Energy Imbalance Price (BPA when NIV > 0 and SPA when NIV < 0)[5].

Energy Variables

Energy volumes (EBVA and ESVA) have an associated cashflow (EBCA and ESCA respectively). A volume weighted average price of all buy and sell contracts is calculated (assuming the direction of individual trades is immaterial) and multiplied by the net energy volume (ECBA or ESVA). The methodology aims to approximate the average price for the associated net energy volume in a Settlement Period. This is shown in the example below.

Example 1: Pricing of Energy Variables

Suppose the SO has a baseload contract that sells (giving a negative volume) -100MWh at £15/MWh. However for a peak Settlement Period the SO buys a contract of 300MWh at £50/MWh.

EBVA = 300MWh + -100MWh = 200MWh

ESVA = 0 (as the volume bought exceeds the volume sold). Therefore ESCA = 0

$$\text{EBCA} = \underbrace{(300 * 50 + |-100|*15)/(300 + |-100|)}_{\text{EBCA}_{price}} * \underbrace{200}_{\text{EBVA}} = £8,250$$

EBCA_{price} = £41.25/MWh

In this case the BSAD is represented in an example NIV stack as in Figure 1. (For simplicity there are no accepted Bids).

[4] These are explained further in section 2.1 of the Definition Report.
[5] The system is considered 'short' when NIV > 0 and 'long when NIV < 0.

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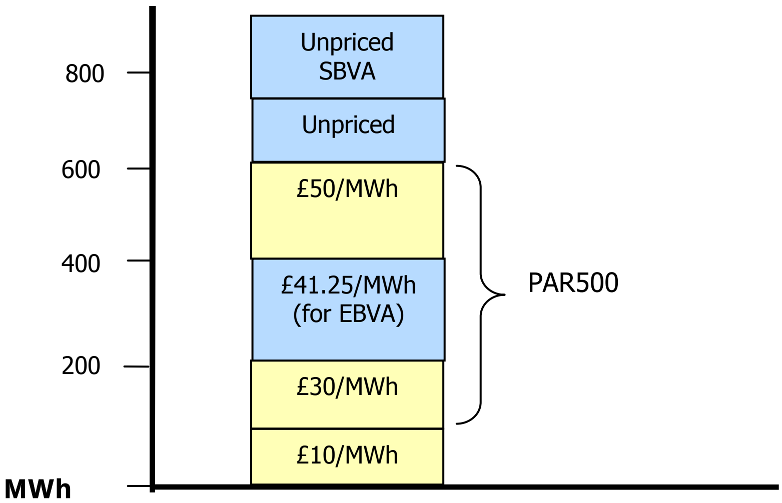
Figure 1. BSAD in the NIV stack – an example



Under Figure 1 the main Energy Imbalance Price would be System Buy Price and would be calculated as[6]:

SBP = (100*30 + 200*41.25 + 50*200)/ 500 + BPA = £42.50/MWh + BPA (1)

So to complete the Energy Imbalance Price Calculation the components that make up the BPA need to be addressed.

BPA and SPA

The BPA is made up of STOR option fees, the availability component of BM start up, options for regulating reserve and option fees of forward contracts.

The SPA is made up of option fees for negative reserve and forward contracts.

In practice, the BPA impacts the main Energy Imbalance Price calculation more frequently than the SPA. This is primarily because option fees for negative reserve and forward contracts occur relatively infrequently compared with STOR option fees and BM start availability fees.

STOR

The STOR option fee component of the BPA (BPA_{STOR})[7] is procured approximately 6 to 12 months ahead of when it is utilised and the costs are reflected approximately into imbalance prices through the BPA using a method based on historic utilisation.

A daily half-hourly profile is built based on historic STOR utilisation. This profile takes into account historic seasonal and business day/non-business day variations. It is used to determine a weighting factor for the allocation of actual option fees to Energy Imbalance Prices in particular periods via BPA.

BPA_{STOR} is calculated as:

- The historic 'representative' utilisation for that Settlement Period; multiplied by
- The option cost of the contracted volume for the day of the current year; with the product divided by

[6] SBP is calculated as described in Section 2.1 of the main consultation document. There is also a Transmission Loss Multiplier that is assumed to be zero in this example.
[7] It should be noted that BPA_{STOR} and BPA_{BMSU} are not official terms, but are variables used here to aid the explanation.

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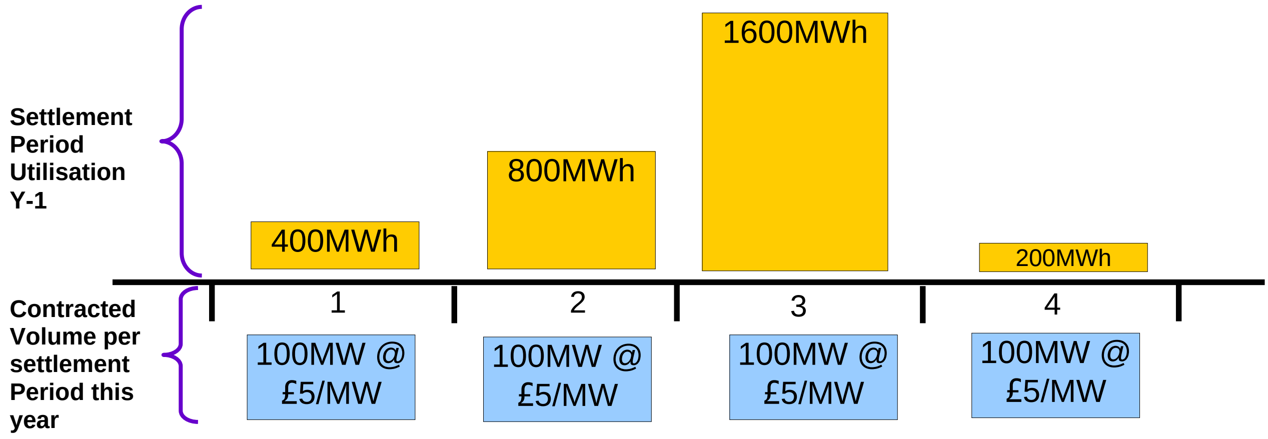
- The contracted option volume for the Settlement Period for the current year.

That is:

$BPA_{STOR} = \Sigma^{1\ to\ n}\ [STOR_{DailyAvailable\ (MWh)} * STOR_{price(£/MWh)}]\ /\ \Sigma^{1\ to\ n}\ STOR_{PeriodAvialable\ (MWh)}$

This can be seen in the example shown in Figure 2 as the volumes in yellow above the timeline. For simplicity, this example assumes that there are only 4 Settlement Periods in the day, and only one day in the year.

Figure 2. STOR component.



Weightings for each Settlement Period are calculated as the historic 'representative' utilisation within the Settlement Period divided by the sum of utilisation across that 'representative' day. From figure 2 this gives the following weightings.

Representative day total utilisation = 400 + 800 + 1600 + 200 = 3000MWh

Period 1 Weighting = 400/3000 = 0.13

Period 2 Weighting = 800/2000 = 0.27

Period 3 Weighting = 1600/2000 = 0.53

Period 4 Weighting = 400/2000 = 0.07

Using the above formula, we can see that, For Settlement Period 1:

$$BPA_{STOR} = [(400 * 5) / 100] * 0.13 = £2.60MWh \quad (2)$$

The second part of the BPA (the BM start up component) needs to be calculated. We will call this BPA_{BMSU}

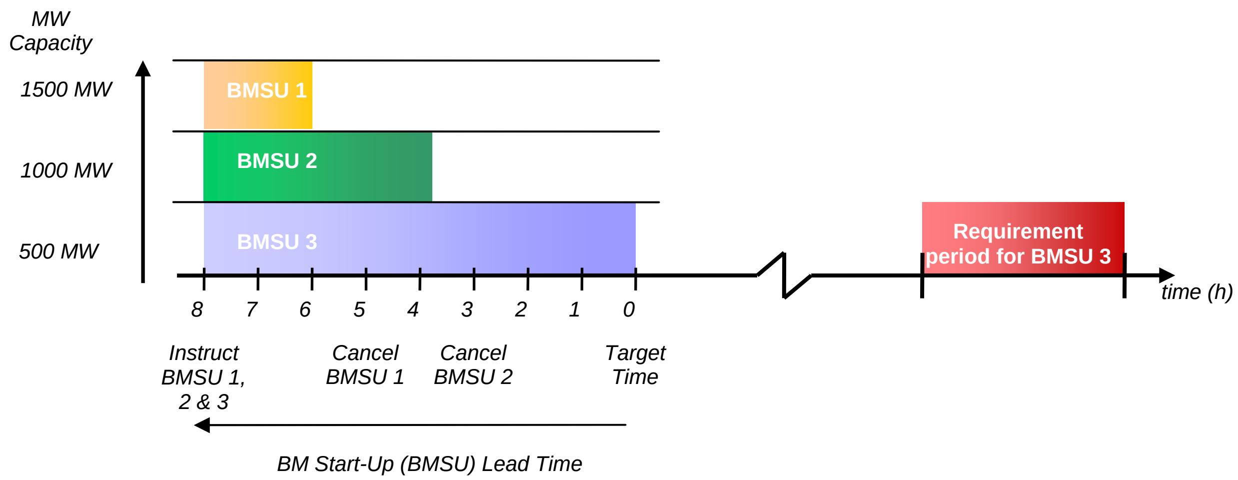
BM Start Up

The SO instructs BM start up units to meet identified additional plant requirements over the peaks. The SO does this for a requirement period (or 'window'). The costs of BM start up are then targeted at the Settlement Periods within this window.

The BM start up component (BPA_{BMSU}) is procured on the day. The cost is allocated through the BPA based on the requirement window. The option fee for BM start up is paid hourly from the time it is instructed and not in full at the time of instruction.

As an example, assume that the SO concurrently instructs three BM start-ups at an 8 hour lead time to meet a requirement of 1500MW for 2 hours in the future. Each BM start-up provides 500MW. Getting closer to the requirement window the SO requires less of the BM start up plant and progressively cancels the prior instructions as in Figure 3. All BM start up in the example is paid at a rate of £2000/hr

Figure 3. BM start up component example



BPA_{BMSU} is then calculated based on summing the per hour cost of the BM start ups instructed (and not cancelled) and dividing it by the MWh[8] requirement for that hour. This gives a cost in £/MWh for that hour. These are then summed from the initial instruction until the target time (or the last BM start up is cancelled). This cost is then allocated to each SP within the requirement window in which SBP is the main price.

Therefore, in the example, the cost for the first hour of the instruction (target time minus 8 hours to target time minus 7 hours) is 3 BM start ups at £2000 = £6000. The total BM start up volume gained (for the window) over the hour was 3000MWh. This gives a cost for that hour of £2/MWh.

This needs to be repeated for the entire time in which the BM start-up was instructed (and not cancelled). This can be seen in Table 2.

Table 2. BM Start Up Example

Lead time (hours)	**T - 8 to T - 7**	**T - 7 to T - 6**	**T - 6 to T - 5**	**T - 5 to T - 4**	**T - 4 to T - 3**	**T - 3 to T - 2**	**T - 2 to T - 1**	**T-1 to Target time**
Total cost for this lead time (£)	6000	6000	4000	4000	2000	2000	2000	2000
Total volume (MWh)	3000	3000	2000	2000	1000	1000	1000	1000
Cost/volume (£/MWh)	2	2	2	2	2	2	2	2

[8] Note the change from MW per Settlement Period to MWh increases the factor by 2.

Then to sum the total £/MWh cost incurred by the Instruction of BM start up we need to add the bottom row of table 2. This gives:

BPA_{BMSU} = (2+2+2+2+2+2+2+2) = £16/MWh. (3)

Therefore £16/MWh is added to the calculation of the BPA for those Settlement Periods within the requirement window. The BPA is then added to SBP when this is the main Energy Imbalance Price in that window.

Combining the Examples

The total BPA sums the BPA calculated for STOR and that calculated for BM start up. This gives:

$BPA = BPA_{STOR} + BPA_{BMSU}$

If we assume that the requirement window of BPA_{BMSU} fell in Settlement Period 1 of the BPA_{STOR} example then:

BPA = £2.60/MWh + £16/MWh = £18.60/MWh (2) + (3)

Furthermore, if we assume that this BPA was for the Energy Imbalance Price calculated in the first example we get a SBP of:

SBP = £42.50 + £18.60 = £61.10/MWh (1) + (2) + (3)

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