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Impact of P74 on Incentive to Spill

1. Introduction

In the Transmission Company Analysis of P74, a central concern is the potential for parties to be better rewarded by spill than by selling in the BM. This is reiterated in answers to questions Q4, Q5 and, especially Q6 (see Assessment Report paragraph 16.1). This was raised in the P74 and P78 Assessment Reports at Sections 6.1.5 and 7.1.5 respectively (of the drafts discussed at PIMG on 3rd July 2002 which replicated the PIMG discussion described in the supporting paper to the first consultation). Members of PIMG were requested to give fuller consideration to this issue. This paper can be viewed in that context.

This paper describes a modelling exercise designed to show the relative revenue impacts of a decision to spill rather than offer power into the BM but noting that spill and contract can have similar impacts on the decision on whether to place BM Offers. The following sections cover:

2. Definition of spill;
3. Derivation of the modelling data and assumptions made;
4. The supplier position;
5. The “Pool” position (zero contracting);
6. The revenue expectations from contract or spill over the relevant demand range;
7. The effect of NGC buying and selling in the same settlement period.

2. Definition of spill

As discussed elsewhere in the Assessment, PIMG has identified two elements to spill: notified spill (i.e. FPN > contract) and un-notified spill (deviation from FPN). The rewards for both are very similar but the latter is a breach of the Grid Code. Given the seriousness of breaching the Grid Code, generators will only do it if there is a clear financial advantage in so doing. With a 1-hour gate closure and limited information as to market length, the opportunities for advantageous deliberate deviation from FPN are likely to be miniscule and so this paper concentrates on notified spill.

Therefore, at or before gate closure, generators will make a decision to either contract with a supplier or spill the energy or leave capacity idle. If the generator contracts with a supplier, the decision as to whether to spill is passed to that supplier – i.e. the supplier is spilling if it over-contracts relative to its forecast of its demand – but the result is the same to NGC in terms of the FPN declared by the generator. In a flip-flop price world as proposed in P74, the supplier's spill decision is informed by its view of whether the market will be long or short.

If the generator decides to spill on its own account, the same essential decision is being made – spill is a punt on market length. The difference is that the generator has the alternative of offering the power to NGC in the BM.

3. Derivation of the modelling data and assumptions made

The model is designed to be illustrative. This means that prices chosen, while not being unrealistic, show a strong spread because it shows up easier on a graph. Volumes are again chosen for convenience of graphing and data generation rather than attempting to exactly mirror a settlement period.

There are three essential elements to the modelling data:

- **Offer stack**

  This is generated from a simple quadratic formula related to demand level ($Offer = 15 + (demand / 4)^2$). This represents what the marginal generator would be prepared to accept at each demand level. Because so many different factors go into offer price, the key assumption is that the price of the individual offer will not vary dependent on market conditions, which is reasonable once we get to the narrower range around actual expected demand.

- **Demand forecast error**

  This is generated from a normal distribution function within the range around the NGC forecast for the settlement period.

- **Bid stack**

  This is essentially notional and assumes a very narrow price spread around the expected range of acceptances. The average bid price will fall as demand increases (relative to forecast).

The data sets used in the graphs are given in the Annex to this paper.

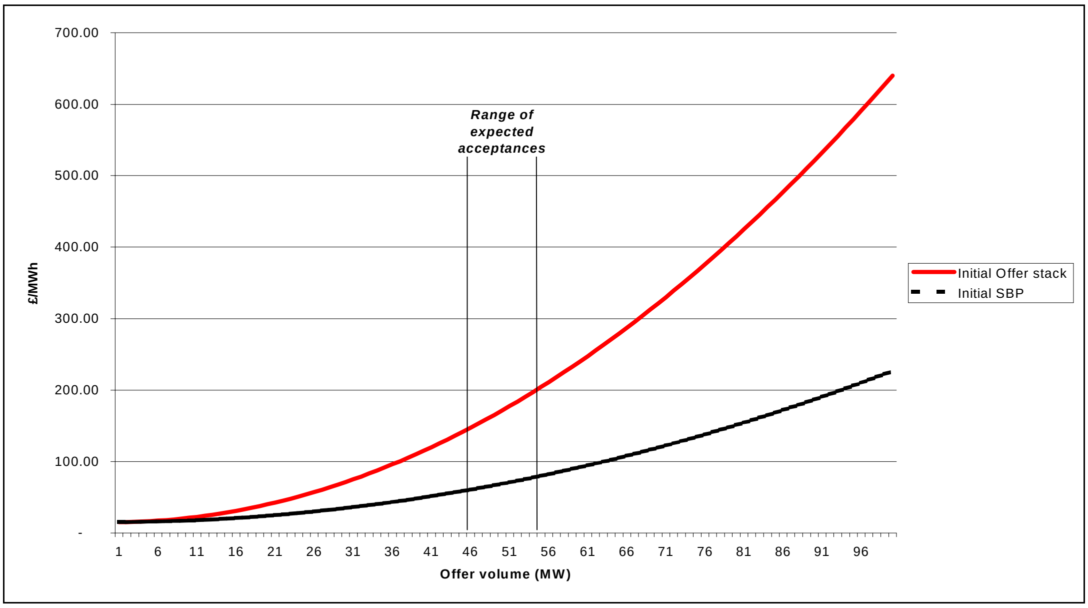
4. The supplier position

In buying energy forward, a supplier is avoiding being cashed out at the buy price. It seems to be generally accepted by the PIMG that suppliers have an incentive to contract and that the price at which they will optimise their position reflects the risk of their exposure to the shortfall price as against the risk of spilling the energy at a low spill price. These risks, under P74, are determined by the expected length of the market. It seems clear that the incentive on the supplier is to contract provided the price is somewhere below the potential buy price.

5. The "Pool" position (zero contracting)

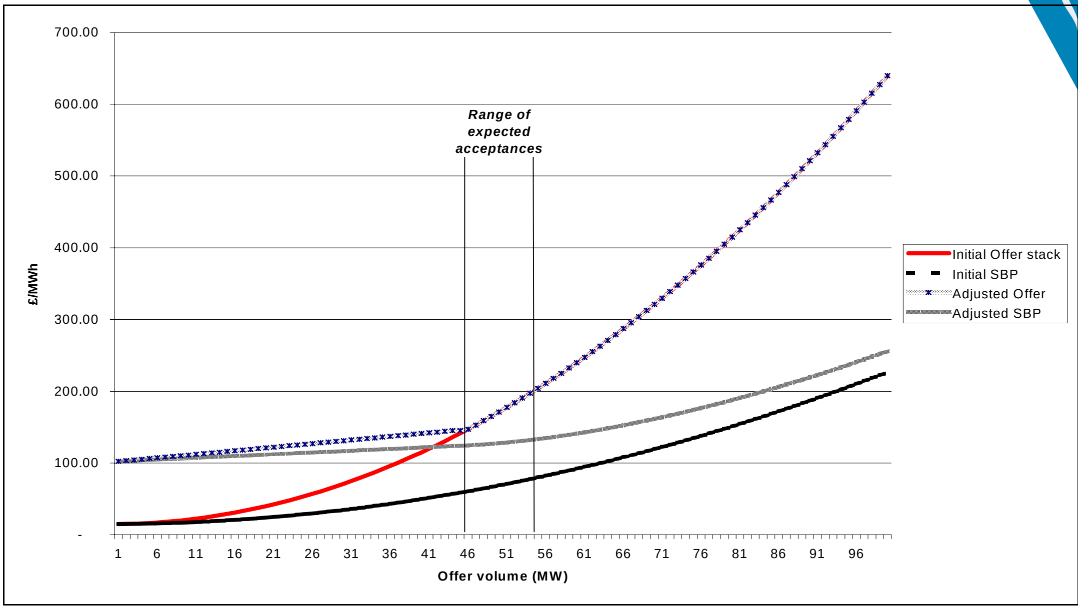
If there is not a strong incentive on generators to contract ahead then they may seek to just take the cash-out price or else to offer into the BM. This looks like the Pool except that the Pool paid marginal price whereas the available prices to the generator are average price (for spill) or pay as bid in the BM. Figure 1 sets out the position in terms of a current Offer stack and the result in SBP. As can be seen, SBP is significantly below the marginal acceptance indicated by the range of probable acceptances. In these circumstances, the spill price is obviously well below what might be achieved in the BM.

Figure 1: Offer stack and resulting SBP



However, Figure 1 assumes that there is no change in Offer behaviour. This is unlikely. Given the range of possible acceptances and the likely prices on offer, generators wishing to be in the money will price their offers as close as possible below the expected marginal acceptance in order to maximise revenue. Figure 2 gives the likely offer stack. As can be seen, the spread between marginal prices and expected SBP narrows considerably, making spill a more realistic proposition.

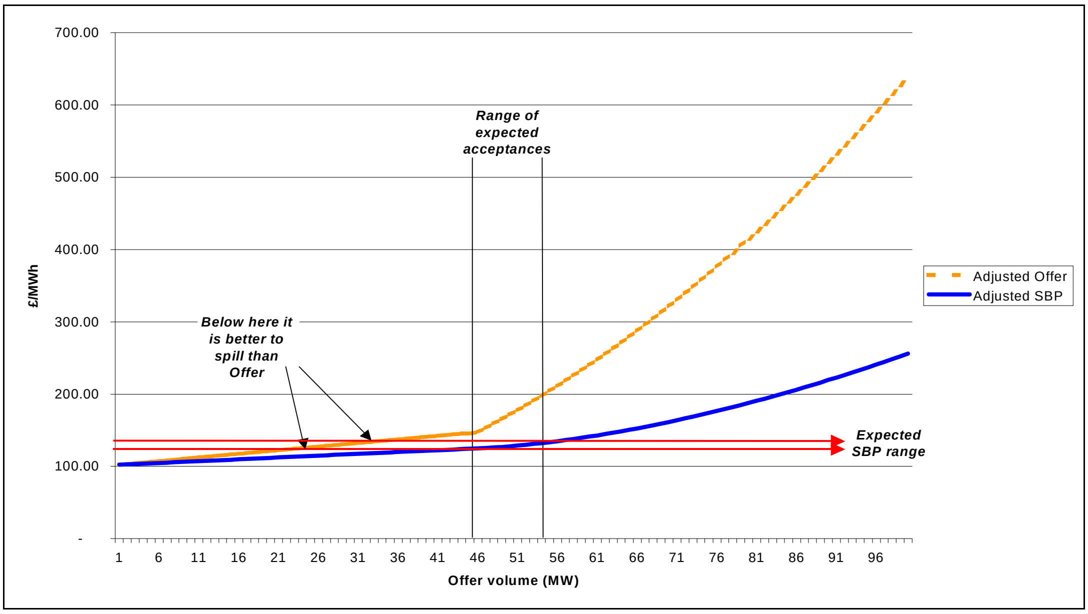
Figure 2: Adjusted Offer stacks and impact on SBP



It should be noted that the effect is all on prices below the range of expected acceptances. Offers within and above this range are priced on an expectation of not always being accepted and so will be marked up accordingly. Such Offers can be expected to be of plant that is normally out of the money (due to high fuel cost) – i.e. specialist peaking plant.

Figure 2 shows that even with a compressed Offer stack below the expected demand range, half the generators would be better off spilling (or contracting at an equivalent price. This, as NGC asserts means that in this range, Offers would not be made. This is illustrated in Figure 3.

Figure 3: Affect of new stack on incentives



The Figure highlights:

- Half of offers accepted would have been better off spilling on an ex post calculation;

- However, ex ante, there is a considerable volume range on where this break-even point is even though there is a small change in price.

The other point to note is the range of expected SBPs will impact on where suppliers would be seeking to contract. As a starting point, the market is guaranteed short and so any price below SBP would be advantageous to suppliers. Therefore, those offering below expected SBP just to try and be in the money have the option of contracting with suppliers as well as spilling.

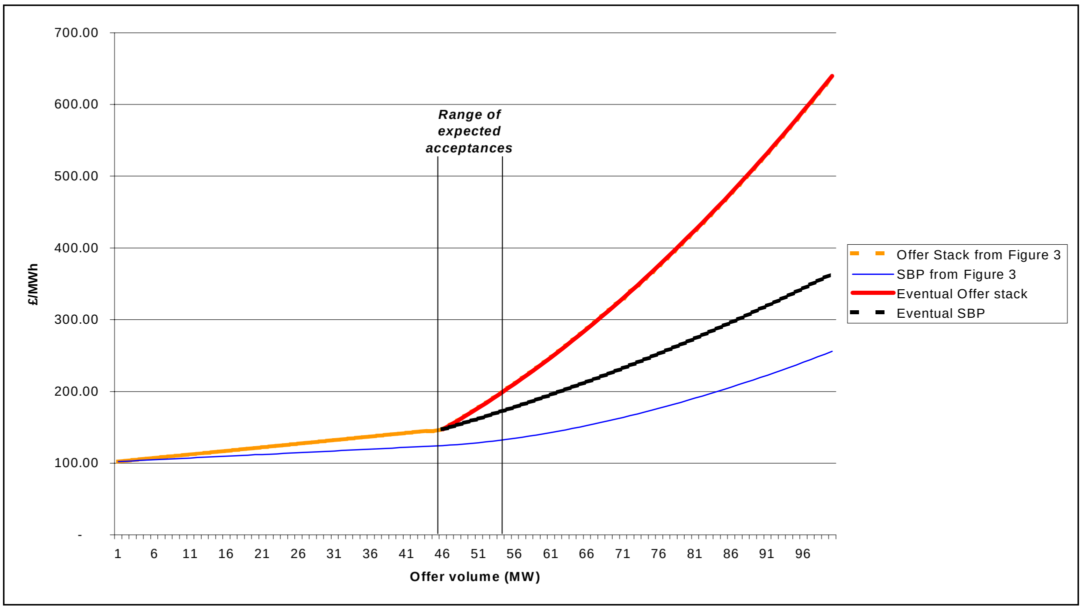
Given the potential (if limited) lack of benefit in offering into the BM rather than spilling, it is suggested that such parties will seek to spill rather than offer. This has the following effects as demonstrated in Figure 4:

- SBP moves up, increasing the incentive to spill;
- Incentive to spill moves eventually to the bottom of the expected buy stack.

Figure 4 shows how SBP moves up until it is being determined by the variable element of the NGC forecast. Generators set FPNs up to this point and are prepared to take spill. The offer stack starts at the point where NGC is taking variable actions.

However, it should be noted that, beyond this point, we are suddenly in a position where NGC could be selling as well as buying. The impact of this is to put the risk back into spill.

Figure 4: Impact of spill on offer stacks



At this stage, it is worth bringing suppliers back into the picture. They are seeking to avoid SBP by contracting at a price below SBP. The shorter the expected market, the higher the price they are prepared to pay. At the point where generator spill could be tipping the market long, the peak price at which suppliers might be prepared to contract will be reached.

Generators are faced with the risk of spill (if other parties contract and tip the market long) or else of contracting. In this market, they will all seek to contract and let the supplier do the spilling if they want. There is no price advantage to the generator in spilling rather than contracting other than from transaction costs. Therefore, they are likely to want to contract.

Therefore, the relevant question posed by the transmission company relates to whether there will be a lack of offers in the much narrower range determined by their forecast error uncertainty. The rest of this paper focuses on this area.

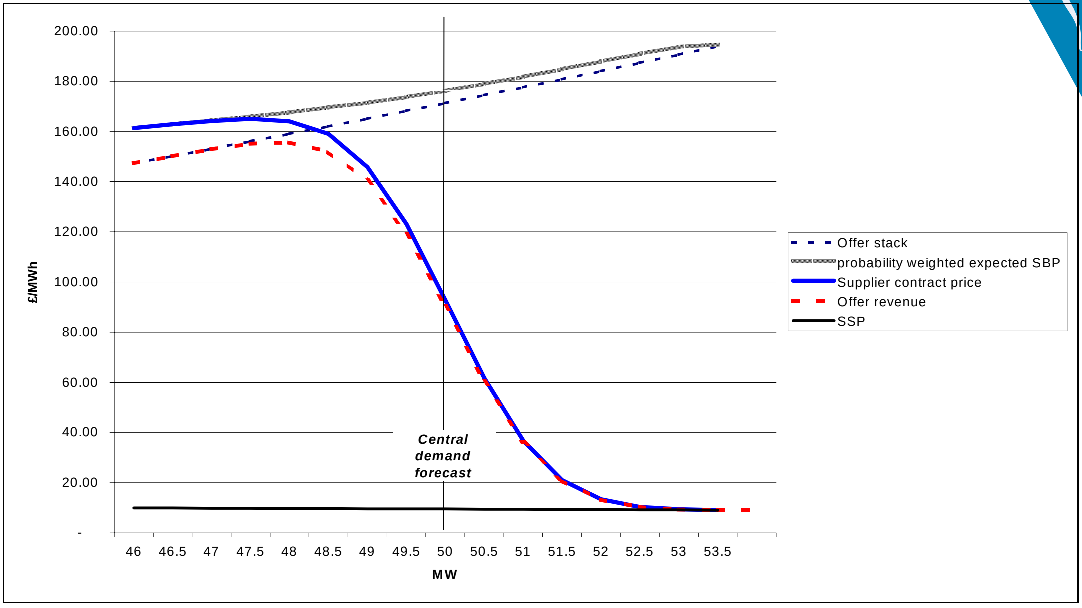
6. The revenue expectations from contract or spill over the relevant demand range

Figure 5 covers the range in the previous figures over which there is uncertainty over the level of demand. It requires some explanation:

- The Offer stack is as derived from the earlier analysis but covering a narrower range.
- Probability weighted expected SBP is derived using the following steps:
    1. A matrix of potential Offer stacks is derived to represent different levels of contract on the assumption that as contract level increases, the cheapest offer in the stack will be converted into a contract (or will be spilled) and will not be available to the BM.
    2. Based on the offer stack matrix, an equivalent SBP matrix is derived from each offer stack representing different levels of actual demand – i.e. different volumes of acceptances. This recognises that the volume of acceptances is determined both by the forecast error and the level of contract (in a long market, the forecast error is managed by varying the volume of Bid Acceptances and in a short market it is managed by varying the volume of Offers accepted).
    3. The normal distribution of demand levels is then applied to each stack in the matrix to give a probable SBP. This is illustrated in Table 1.

  Probability weighted SBP is therefore calculated for each level of potential contract and it is these probabilities that are plotted along the line.

Figure 5: Expectations of SBP and optimised contract/spill prices



- Supplier contract price is the price suppliers would pay to avoid SBP and is derived from the formula:

  *Price = expected SBP * probability of market short + expected SSP * probability of market long*

  It should be noted that as the market gets more contracted (longer) the probability of the spill price being SSP increases and so suppliers are prepared to pay less in the contract. If the market is very long, the contract price will collapse towards SSP.

- Offer revenue is calculated by applying the probability of NGC buying at a certain volume (the same probability as was used to derive the probability weighted expected SBP) and the price in the offer stack at that demand level.

- SSP is just a crude extrapolation around estimated fuel costs in the market.

The chart shows that that generators are better off contracting than offering but that when we get to a balanced to long market this advantage becomes negligible. However, crucial to arriving at this conclusion is the assumption that the probability of the market being short is the same as the probability of offer acceptance. This only happens if NGC only buys or sells in the settlement period. The next section relaxes this assumption.

Table 1: Derivation of probability adjusted SBP

row number	Demand level	Offer stack	SBP stack at contract level 49.5	Demand probability	Cumulative demand probability	weighting for contract level 49.5	weighted contribution to SBP	Probabilities of system buying	Probability adjusted SBP
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
1	46	147.25		0.0001	0.0000			1.0000	
2	46.5	150.14		0.0004	0.0002			0.9998	
3	47	153.06		0.0022	0.0013			0.9987	
4	47.5	156.02		0.0088	0.0062			0.9938	
5	48	159.00		0.0270	0.0228			0.9772	
6	48.5	162.02		0.0648	0.0668			0.9332	
7	49	165.06		0.1210	0.1587			0.8413	
8	49.5	168.14	168.14	0.1760	0.3085	0.15	25.20	0.6915	29.95
9	50	171.25	169.70	0.1995	0.5000	0.19	32.49	0.5000	38.62
10	50.5	174.39	171.26	0.1760	0.6915	0.19	32.79	0.3085	38.97
11	51	177.56	172.84	0.1210	0.8413	0.15	25.91	0.1587	30.79
12	51.5	180.77	174.42	0.0648	0.9332	0.09	16.02	0.0668	19.04
13	52	184.00	176.02	0.0270	0.9772	0.04	7.75	0.0228	9.22
14	52.5	187.27	177.63	0.0088	0.9938	0.02	2.94	0.0062	3.49
15	53	190.56	179.24	0.0022	0.9987	0.00	0.87	0.0013	1.04
16	53.5	193.89	180.87	0.0004	0.9998	0.00	0.20	0.0002	0.24
17	54	197.25	182.51	0.0001	1.0000	0.00	0.04	0.0000	0.04
18	54.5	200.64	184.16	0.0000	1.0000	0.00	0.01	0.0000	0.01
									171.41

Notes:
- (a) *MW*
- (b) *£/MWh*
- (c) *e.g. row 10 = average (row 10: row 18)*
- (d) *Normal distribution around demand level 50 (row 9)*
- (e) *Cumulative probability density of same distribution*
- (f) *e.g. row 10 (i.e. f10) = e10-e9*
- (g) *column (f) x column (c)*
- (h) *equals 1 - column (f)*
- (i) *equals column (g) / h7*

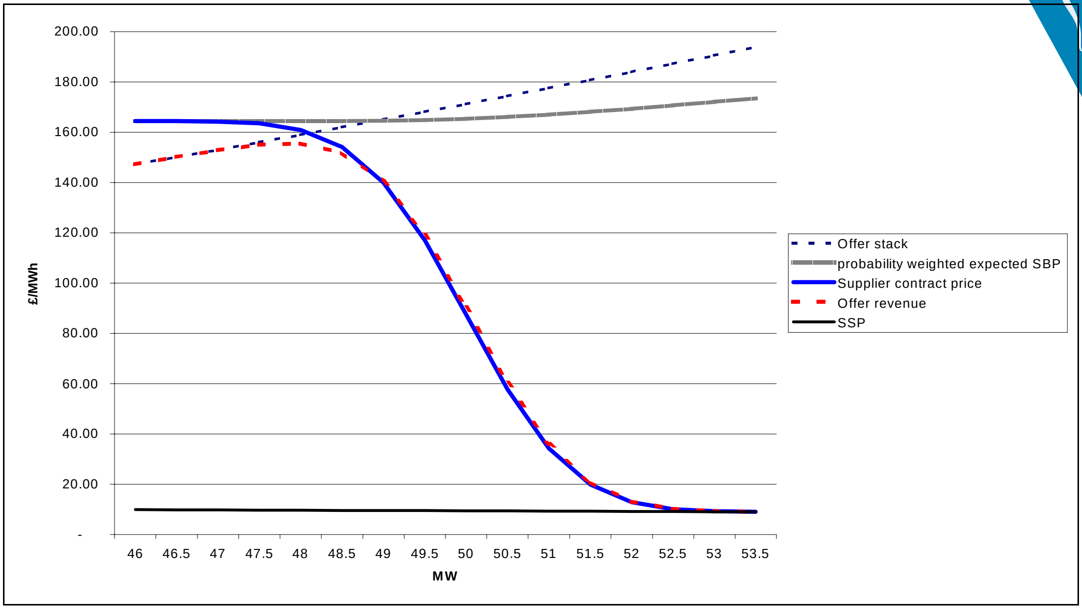
7. The effect of NGC buying and selling in the same settlement period

Figure 6 is the same as Figure 5 with one crucial difference. Because of late changes in demand, reserve procurement, constraint management and other reasons, the probability of NGC buying is greater than the probability of the system overall being net short. This has been modelled by assuming that, while demand outcomes are normally distributed around the mean demand level of 50, the probability of Offer Acceptance is distributed around the level of 51. This is a very modest change.

The crucial changes are:

- An increase in probability of acceptance reduces the probability weighted set of expected SBPs;
- This line now largely falls below the potential Offer stack;
- This effect is increased once BSAD is considered (especially using the NIV methodology from P78 for setting prices from the main stack);
- As soon as the market has moved longer, the probability weighted revenue from Offer Acceptance exceeds the spill value at any particular expected balance.

Figure 6: Expectations of SBP and optimised contract/spill prices with increased Offer Acceptance probability



8. Conclusion

- Although there is a prima facie case for suggesting that an average Buy Price is going to offer a better reward to a generator than offering the power to NGC, this view takes insufficient account of:
  1. the risk exposure to SSP of such a strategy;
  2. the equal advantage derived from contracting.
- Once recognising that the probability of NGC buying in the BM is a higher than the probability of the system being short, there is a risk-adjusted advantage to offering into the BM rather than spilling/contracting.
- This risk-adjusted advantage is sensitive to the level of contracting and stabilises around the balanced market.

Finally, it should be noted that this analysis has assumed that everybody has a fuel cost around SSP. As we move up the stacks to greater contract levels, the parties making the decision as to whether they should offer rather than contract/spill will be deciding against a fuel cost that is above SSP. Although this factor has not been modelled here, it should be considered that the risk-cost of spill increases with fuel cost and that such parties will always prefer an Offer Acceptance to spill because they only incur the fuel cost on such Acceptance whereas, if they spill they face the fuel cost but risk being cashed out at a lower price.

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