ELEXON

Stage 03: Attachment A: Detailed Assessment for P276

What stage is this document in the process?

01 Initial Written Assessment

02 Definition Procedure

03 Assessment Procedure

04 Report Phase

P276 'Introduce an additional trigger/threshold for suspending the market in the event of a Partial Shutdown'

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About This Document:

This is Attachment A to the Workgroup's Assessment Report and the BSC Panel's Modification Report.

It provides additional details of the Workgroup's analysis, Terms of Reference and membership.

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1 Existing BSC Agent Black Start Processes

Balancing Mechanism Reporting Agent (BMRA)

National Grid may publish a System Warning on the Balancing Mechanism Reporting Service (BMRS) stating that there is a Total or Partial Shutdown.

The BMRS will initially continue to publish (incorrect) System Buy Price / System Sell Price information, and to issue TIBCO messages where possible.

As soon as practicable, the BMRA will publish a note on the BMRS stating that these prices are inaccurate and that all contract positions are zero during the Black Start Period.

Once the BSC Panel has agreed the methodology for calculating the single imbalance price (in accordance with Section T1.7), ELEXON will notify BSC Parties of this methodology and will calculate the resulting price. The BMRS will then publish this single imbalance price information.

Energy Contract Volume Aggregation Agent (ECVAA)

During a Partial Shutdown, Parties outside the shutdown area may be unaware initially of the situation and may continue to submit Energy Contract Volume Notifications (ECVNs) and Metered Volume Reallocation Notifications (MVRNs).

The ECVAA will still send reports back, but will nullify manually all contract notifications for Settlement Periods within the Black Start Period. This will not affect existing contract notifications in place for Settlement Periods after the end of the Black Start Period.

Once the Total System is re-energised, the ECVAA will issue the 7-day forward contract report to Parties with the caveat that all contract positions remain zero until normal BSC operations resume.

The ECVAA will manually set each Party's energy indebtedness to zero for all Settlement Periods within the Black Start Period.

Settlement Administration Agent (SAA)

The SAA will manually adjust System Buy Price and System Sell Price values to match the single imbalance price provided by ELEXON for all Settlement Periods within the Black Start Period.

Other BSC Agents (e.g. Central Data Collection Agent, Supplier Volume Allocation Agent, Funds Administration Agent)

Other BSC Agents will continue normal operations where possible.

Aggregation, Volume Allocation, Settlement and Payment Runs will be delayed if necessary. For example SAA runs will be postponed until the BSC Panel has determined the single imbalance price methodology, ELEXON has calculated this price, and the SAA has entered it in its systems. ELEXON will notify Parties of any revised run dates.

Purpose of this section

This section describes the BSC Agent processes which support the BSC's existing Black Start provisions.

These processes were discussed and agreed by the BSC's Standing Issue 32 Group[1] and the P231 Workgroup.

You can find more information in the Issue 32 Report, P231 Assessment Report and BSCP201.

Under P276, all of these processes will continue to apply to Total Shutdowns and to Partial Shutdowns in which the market is suspended. As now, the processes will be enacted post-event if necessary.

[1] Issue 32 'Black Start' resulted in Modification Proposals P231 'Black Start and Fuel Security Code Procedures under the Balancing and Settlement Code' and P232 'Black Start and Fuel Security Compensation and Single Imbalance Price Derivation'.

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2 P276 Black Start Period and Market Suspension Period

Purpose of this section

This section illustrates the interaction between the Black Start Period and any Market Suspension Period under P276.

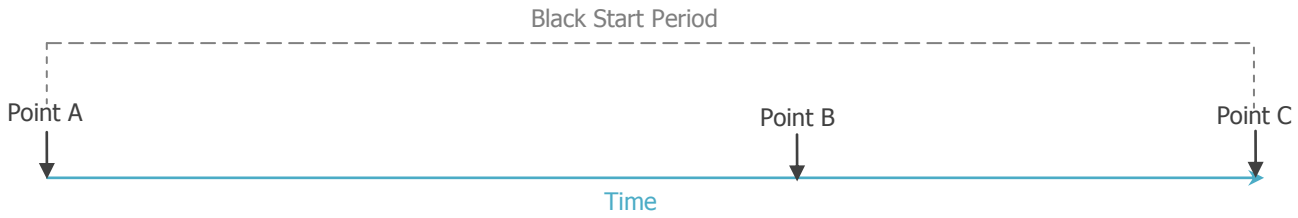
Summary

Currently, the BSC's Black Start Period (during which the market is suspended automatically) runs from Point A to Point C:

Point A: The start of the Settlement Period determined by ELEXON as corresponding with the time and date from which National Grid determines that the Total Shutdown or Partial Shutdown began.

Point B: The time and date determined by National Grid as being when the Total System returns to normal operation.

Point C: The end of the Settlement Period immediately before that from which the BSC Panel determines that normal BSC market operations shall resume.



However, under P276 there will now be an additional point to consider (which we'll call Point X).

This Point X is the Settlement Period during which the Market Suspension Threshold is met, and from which the BSC's Market Suspension Period begins.

Total Shutdown

If National Grid notifies Grid Code Users and ELEXON of a Total Shutdown, then the BSC will automatically deem this to meet the Market Suspension Threshold.

Point X will therefore be identical to Point A, and the Market Suspension Period following a Total Shutdown will therefore run in parallel with the BSC's Black Start Period from Point A to Point C as currently.

As now, the market will therefore be suspended between Points A/X and Point C (see diagram on the following page).

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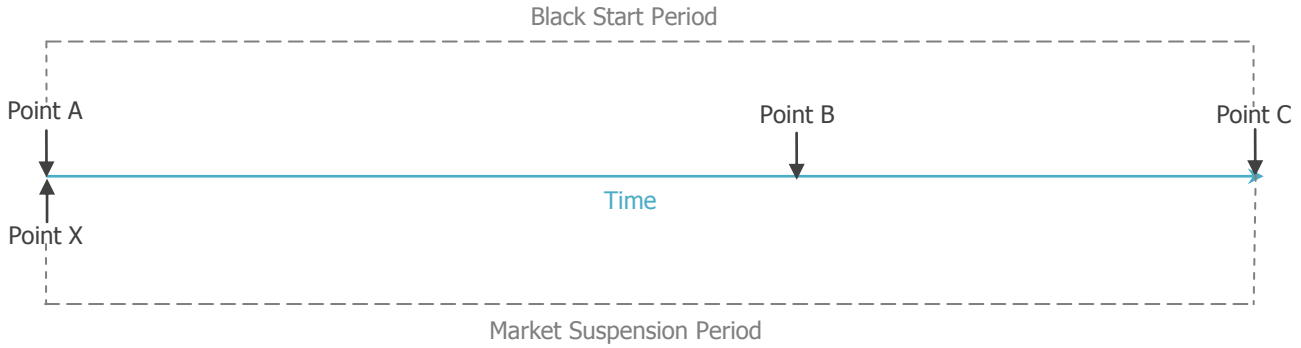
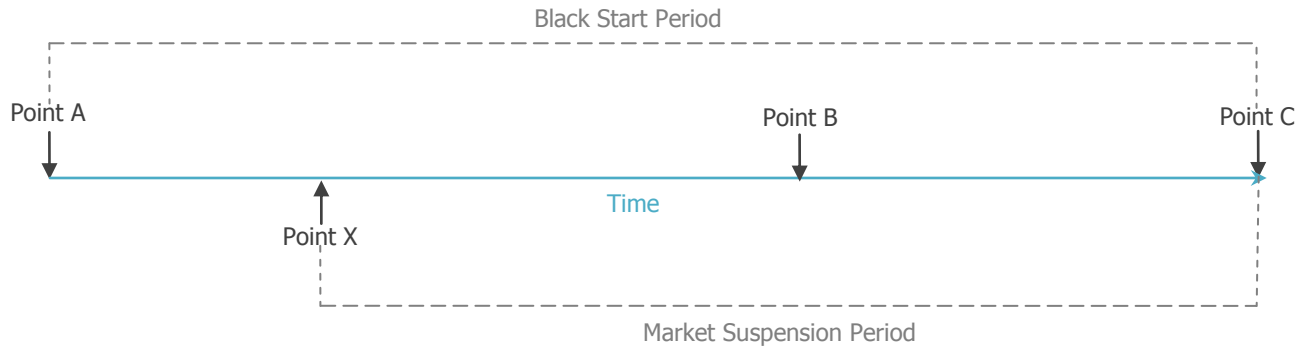


Partial Shutdown

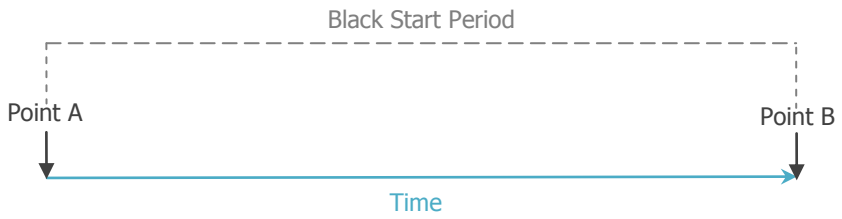
If National Grid notifies Grid Code Users and ELEXON of a Partial Shutdown, the BSC's Black Start Period will still begin at Point A.

When and if the Market Suspension Threshold is met, ELEXON will determine the Settlement Period which corresponds with the time/date that the threshold was met and the Market Suspension Period will begin from the start of this Settlement Period (Point X).

- If the Market Suspension Threshold is met during the same Settlement Period in which the Partial Shutdown began, then Points A and X will be identical and both the Black Start Period and the Market Suspension Period will run from Points A/X to Point C as in the Total Shutdown example. The market will therefore be suspended between Points A/X and Point C.
- If the Market Suspension Threshold is only met some time after Point A, then the Market Suspension Period will only run from Point X to Point C. The Black Start Period itself will still run from Point A to Point C (see diagram below).



If the Market Suspension Threshold is not met between Points A and B, then there is no Market Suspension Period and the BSC's Black Start Period will run from Point A until the Total System returns to normal operation at Point B (there will be no Point C).



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3 Key BSC Market Events and Communications under P276

<table>
<tr><th colspan="3">Comparison of key events for BSC market operations during a Partial Shutdown</th></tr>
<tr><th>Existing rules</th><th colspan="2">P276 rules</th></tr>
<tr><td>National Grid identifies under Grid Code that Partial Shutdown exists.</td><td colspan="2">National Grid identifies under Grid Code that Partial Shutdown exists <u>and</u> begins monitoring Market Suspension Threshold.</td></tr>
<tr><td rowspan="2">National Grid notifies relevant Grid Code Users and ELEXON that Partial Shutdown exists.

ELEXON (as soon as practicable) informs BSC Parties that Partial Shutdown exists.</td><td colspan="2">National Grid notifies relevant Grid Code Users and ELEXON that Partial Shutdown exists.</td></tr>
<tr><td colspan="2">ELEXON (as soon as practicable) informs BSC Parties that Partial Shutdown exists.</td></tr>
<tr><td>As soon as practicable, National Grid determines time and date from which Partial Shutdown began and informs ELEXON.</td><td colspan="2">As soon as practicable, National Grid determines time and date from which Partial Shutdown began and informs ELEXON.</td></tr>
<tr><td rowspan="4">ELEXON determines corresponding Settlement Period and (as soon and so far as practicable) notifies BSC Parties.
Start of this Settlement Period is start of BSC's Black Start Period <u>and</u> market suspension.</td><td colspan="2">ELEXON determines corresponding Settlement Period and (as soon and so far as practicable) notifies BSC Parties.
Start of this Settlement Period is start of BSC's Black Start Period, <u>but not necessarily</u> the start of any market suspension. Grid Code change needed to reflect this.</td></tr>
<tr><th>If Market Suspension Threshold is met:</th><th>If Market Suspension Threshold is not met:</th></tr>
<tr><td>Where relevant, and as soon as practicable, National Grid notifies ELEXON of time and date that Market Suspension Threshold met.</td><td rowspan="3">ELEXON keeps BSC Parties informed of:
• Operation of BSC Systems (as soon and so far as practicable)
• Operation of Transmission System (insofar as informed by National Grid).</td></tr>
<tr><td>ELEXON determines Settlement Period corresponding with time and date that Market Suspension Threshold met and (as soon and so far as practicable) notifies BSC Parties.
Start of this Settlement Period is start of BSC's Market Suspension Period. This may or may not be the same Settlement Period from which Black Start Period began.</td></tr>
<tr><td>ELEXON keeps BSC Parties informed of:
• Operation of BSC Systems (as soon and so far as practicable)
• Operation of Transmission System (insofar as informed by National Grid).</td><td>ELEXON keeps BSC Parties informed of:
• Operation of BSC Systems (as soon and so far as practicable)
• Operation of Transmission System (insofar as informed by National Grid).</td></tr>
<tr><td>National Grid determines time that Total System could return to normal operation and informs Grid Code Users and ELEXON.</td><td>National Grid determines time that Total System could return to normal operation and informs Grid Code Users and ELEXON.</td><td>National Grid determines time that Total System could return to normal operation and informs Grid Code Users and ELEXON.</td></tr>
<tr><td rowspan="3">The BSC Panel determines (after consultation with National Grid) the Settlement Period from which normal BSC market operations will resume.

ELEXON promptly notifies BSC Parties of Settlement Period from which BSC Panel determines that market shall resume.
End of Settlement Period immediately before this is end of BSC's Black Start Period.</td><td>The BSC Panel determines (after consultation with National Grid) the Settlement Period from which normal BSC market operations will resume.</td><td>National Grid determines time that Total System has returned to normal operation and informs ELEXON.
Grid Code change needed to require National Grid to inform Grid Code Users.</td></tr>
<tr><td>ELEXON promptly notifies BSC Parties of Settlement Period from which BSC Panel determines that market shall resume.
End of Settlement Period immediately before this is end of both BSC's Black Start Period <u>and</u> BSC's Market Suspension Period.</td><td rowspan="2">ELEXON determines corresponding Settlement Period and promptly notifies BSC Parties.
End of this Settlement Period is end of BSC's Black Start Period.
Grid Code change needed to reflect that this is the point at which both BM and Total System have returned to normal, and Grid Code's Black Start provisions end.</td></tr>
<tr><td>National Grid notifies Grid Code Users of Settlement Period from which BSC Panel determines that market shall resume.
This Settlement Period is when Grid Code deems both BM and Total System to have returned to normal, and when Grid Code's Black Start provisions end.</td><td>National Grid notifies Grid Code Users of Settlement Period from which BSC Panel determines that market shall resume.
This Settlement Period is when Grid Code deems both BM and Total System to have returned to normal, and when Grid Code's Black Start provisions end.</td></tr>
<tr><td>Lead Party for any BM Unit given black start instruction during Black Start Period can claim black start compensation under BSC.
CUSC's Interruption Payments do not apply.</td><td>Lead Party for any BM Unit given black start instruction during Black Start Period can claim black start compensation under BSC.
Definition of black start instruction and compensation calculation is <u>unchanged</u> for any Settlement Period which falls in both Black Start Period and Market Suspension Period.
CUSC's Interruption Payments do not apply to any Settlement Period which falls in both Black Start Period and Market Suspension Period.</td><td>Lead Party for any BM Unit given black start instruction during Black Start Period can claim black start compensation under BSC.
Definition of black start instruction and compensation calculation is <u>different</u> for any Settlement Period which falls in Black Start Period but not Market Suspension Period (though intention of calculation is unchanged).
Workgroup recommends extending CUSC's Interruption Payments to Settlement Periods falling in Black Start Period but not Market Suspension Period.</td></tr>
</table>

4 Analysis of Appropriate Market Suspension Threshold

Aim of analysis

ELEXON's analysis aims to determine a Market Suspension Threshold level that will (on average) minimise the disruption to Settlement cash flows arising from Partial Shutdowns. As the threshold value is not expected to affect either the number of Partial Shutdowns or the steps taken to resolve them by National Grid as System Operator, the analysis focuses on determining whether (for different sizes of Partial Shutdowns) it is better to suspend or continue the market:

- If the market is suspended, Settlement becomes less cost-reflective for those Parties unaffected by the Partial Shutdown. The bilateral contracts they have struck with each other (at prices determined in the market) are set aside, and instead their entire Metered Volume is settled on a single imbalance price (which is derived from historic data, and does not necessarily reflect market forces on the day in question).
- Conversely, if the market is not suspended, those Parties who are affected by the Partial Shutdown (and have been thrown into imbalance due to demand and/or generation being forced off the system) have no protection from imbalance charges. They are left exposed to additional imbalance charges, as a result of events on the Transmission System over which they have no control.

Which of these two effects is more significant depends on the size of the Partial Shutdown:

- For a sufficiently small Partial Shutdown, the impact on affected Parties of allowing the market to continue is small compared to the impact of suspending the market, and therefore the market should not be suspended.
- For a sufficiently large Partial Shutdown, the impact on affected Parties of allowing the market to continue is large compared to the impact of suspending the market, and therefore the market should be suspended.
- In between these two extremes is a point where the two costs become equal, i.e. the total cost to Parties is the same regardless of whether or not the market is suspended. This represents the appropriate level of the Market Suspension Threshold, beyond which the market should be suspended.

Scope and approach

In order to allow for seasonal differences, we have performed the analysis for three separate months (January 2011, April 2011 and July 2011).

To model the impact of suspending the market on Parties not directly affected by the Partial Shutdown, we have calculated the difference (for each Settlement Period) between the single imbalance price and the Market Price[2]. We have then calculated the average absolute value of this difference across all Settlement Periods in the month, to give an estimate of the distortion to 'true' prices which is caused by setting aside bilateral contracts and settling on a single imbalance price determined from historic data.

Purpose of this section

At the Workgroup's request, ELEXON has analysed the point at which the disruption to BSC Parties' imbalance charges caused by continuing the market becomes greater than that caused by suspending it.

This point represents the suggested appropriate level for the Market Suspension Threshold under P276.

This section describes the analysis aims, scope, results and conclusions.

You can find the Group's discussion of the analysis in Section 3 of the main report.

[2] The Market Price is the price determined using data from Market Index Data Providers under BSC Section T1.5.

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To model the impact of not suspending the market on Parties directly affected by the Partial Shutdown, we have needed to make appropriate assumptions about the impact on their imbalance volumes. This depends on the mixture of demand and generation in the affected area. Note that, for the purposes of our analysis, we have assumed that all Bid-Offer Acceptances issued outside the shutdown area will be treated as energy-balancing actions and will therefore feed into the calculation of SBP/SSP in the normal way.

- A Partial Shutdown that mainly forces demand off the system will leave affected Suppliers with 'long' positions (and potentially force them to sell power at System Sell Price that they previously purchased at a higher market price). The impact on their imbalance charges is likely to be exacerbated by National Grid having to accept Bids to remove generation from the unaffected part of the system (as the demand it was intended to meet is no longer there), driving down System Sell Price in the process.
- A Partial Shutdown that mainly forces generation off the system will leave affected generators with 'short' positions (and potentially force them to buy power at System Buy Price that they previously sold at a lower market price). The impact on their imbalance charges is likely to be exacerbated by National Grid having to accept Offers to increase generation on the unaffected part of the system (to replace that lost in the Partial Shutdown), driving up System Buy Price in the process.
- A Partial Shutdown that forces equal amounts of demand and generation off the system will leave some Suppliers with 'long' positions and some generators with 'short' positions, but will not have the same distorting effect on cash-out prices as the other scenarios (because demand and generation remain in balance, and National Grid is therefore not forced to take additional energy balancing actions).

Of these scenarios, the P276 Workgroup believes that exposure to System Buy Price (SBP) is the 'worst case' for BSC Parties, and we have therefore focused our analysis on modelling this scenario. This requires us to reconstruct the stack of Offers available to National Grid in each Settlement Period, and to calculate how the SBP (i.e. the volume-weighted price of the most expensive 500MWh of Offers) would increase in response to National Grid having to accept Offers to replace the generation lost in a Partial Shutdown. We have calculated this for various sizes of Partial Shutdown, ranging from 1% to 20% of total generation.

Approach to reconstructing the stack of offers available to National Grid

Our starting point for reconstructing the stack of available Offers is the Bid-Offer Pairs, Final Physical Notification (FPN) and Maximum Export Limit (MEL) data submitted by Lead Parties in each Settlement Period. The volume between the period FPN and period MEL is potentially available to National Grid at the relevant Offer price.

However, not all of these Offers will be available in reality, due to plant inflexibility. We have therefore further restricted the stack of available Offers to BM Units which are either:

- Already running (as these will already be synchronised, and are likely to be capable of increasing output to their declared MEL if required to do so); or
- Identified as typically having a Notice to Deviate from Zero (NDZ) of less than fifteen minutes. Using a manual process we have identified 45 BM Units (mainly gas turbines, located within 25 separate power stations) that fall into this category.

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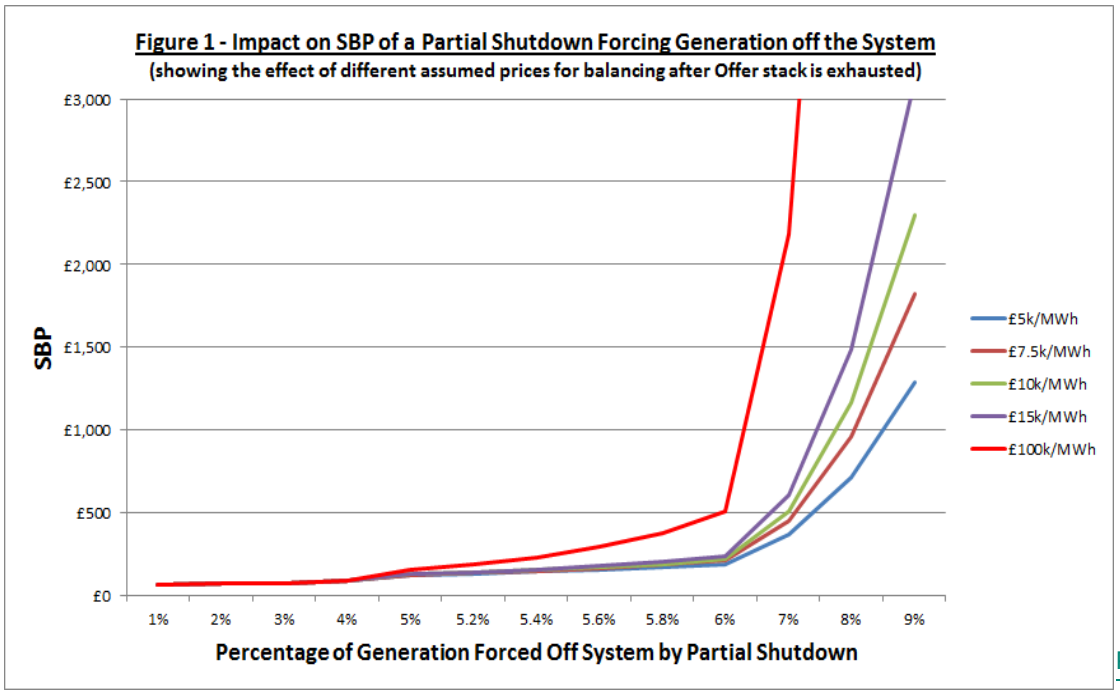
This process produces a stack of Offers for each Settlement Period that we assume, for the purposes of the modelling, to be available to National Grid. However, as these stacks only contain finite volumes of Offers, there comes a point for each Settlement Period at which (as the volume of Offers required is increased) the stack becomes exhausted.

At this point, National Grid will have to take some other balancing action, beyond those we have identified as available. This could take the form of Demand Control (ultimately leading to disconnection of customers), or it could be some other form of balancing action not included in the Bid-Offer data. For the purposes of the modelling, we have decided to include these poorly-understood balancing actions in the stack as a large volume available to National Grid, but at a high price. However, choosing the appropriate (high) price for this hypothetical 'balancing action of last resort' is difficult:

- To the extent that this balancing action represents disconnection of customers, it would be logical to price it at those customers' Value of Lost Load (VoLL). However, we don't know what that is (and it will be different for different customers).
- To the extent that this balancing action represents other balancing services available to National Grid that don't require disconnection of customers but are not included in the Bid-Offer data, we simply don't know what an appropriate price would be.

To address this uncertainty, we have repeated the calculation for a wide range of prices, ranging from £5,000/MWh to £100,000/MWh. We believe this range is wide enough to include VoLL for most customers, as well as the prices of any other balancing services that would be plausibly available to National Grid at a time of extreme system stress when all available Offers have been utilised.

Figure 1 shows how the chosen price has an increasing impact on SBP as the size of the Partial Shutdown increases. The data is averaged across all Settlement Periods in April 2011:



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For small Partial Shutdowns (forcing 4% or less of total generation off the system) it makes no difference what price we assume for balancing actions beyond the stack of available Offers (because such actions are never required). But as the amount of generation lost increases, such actions begin to be required in certain Settlement Periods, and the price assigned to them therefore begins to impact the average System Buy Price.

Reason for excluding charges required to fund payments to generators

As described above, the analysis focuses on the disturbance which a Partial Shutdown causes to imbalance charges. We have also considered whether to include the impact on Parties of funding payments to those generators who are required to provide balancing services on the unaffected part of the Transmission System, given that a decision to suspend the market changes the funding mechanism:

- If the market is not suspended, we assume that instructions issued by National Grid to generators on the unaffected part of the system will be treated as Bid Offer Acceptances, and will be funded by Parties through Balancing Services Use of System (BSUoS) charges.
- If the market is suspended, the same instructions will be treated as black start instructions. Generators will recover their costs by applying for black start compensation, and these payments will be recovered from Parties through the BSC arrangements.

Although the payment mechanisms are different, the same generators are being paid to deliver the same services in each case. While there may be some differences in the amounts recovered due to the different rules that apply, it seems reasonable to assume that (to a first order of approximation) the generators will recover their costs in each case. We do not have any reason to expect a systematic difference in the total amounts paid under the two scenarios, and have therefore concluded that these cash flows do not significantly impact the appropriate level for the Market Suspension Threshold.

Results

For each month (and for a range of different assumed prices for actions taken after the Offer stack is exhausted) we have calculated the point at which the disturbance to Parties' cash flows of suspending the market equals that of not suspending it.

For example, Figure 2 on the following page shows the data for April 2011 and a price of £5,000/MWh once the Offers have all been used (SIP = single imbalance price). The curves cross when the size of the Partial Shutdown (i.e. amount of generation lost from the system) reaches 5.4%:

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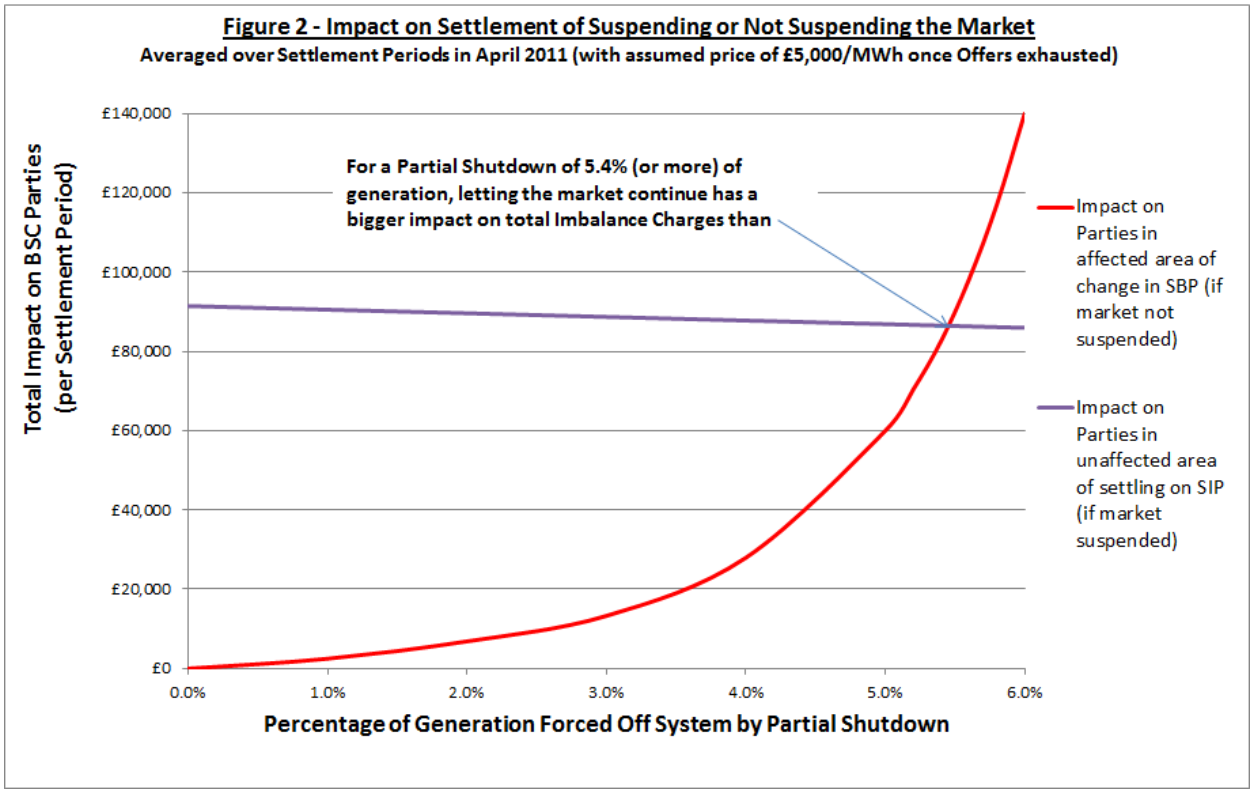

The following table shows the results for each month modelled:

Size of Partial Shutdown (as % of Total System) at which suspending the market reduces total disruption to cash flows					
Month	**Assumed price for balancing actions once all offers used (£/MWh)**				
	£5000	**£7,500**	**£10,000**	**£15,000**	**£100,000**
Jan 2011	4.6%	4.4%	4.3%	4.2%	3.7%
Apr 2011	5.4%	5.4%	5.4%	5.3%	5.0%
Jul 2011	5.4%	5.4%	5.4%	5.4%	5.4%

Conclusions

The analysis shows that (in the worst-case scenario of a Partial Shutdown affecting generation rather than demand, and in which all Offers taken in the functioning part of the system feed into the calculation of SBP) the threshold at which suspending the market reduces the impact on Parties is 5% of total demand.

For other scenarios (e.g. a Partial Shutdown affecting primarily demand) the appropriate threshold would be higher. However, the analysis shows that a higher threshold could expose Parties to extremely high SBP, and hence extremely high imbalance charges, in the worst-case scenario. This suggests that the threshold should not be set any higher than 5% of total demand.

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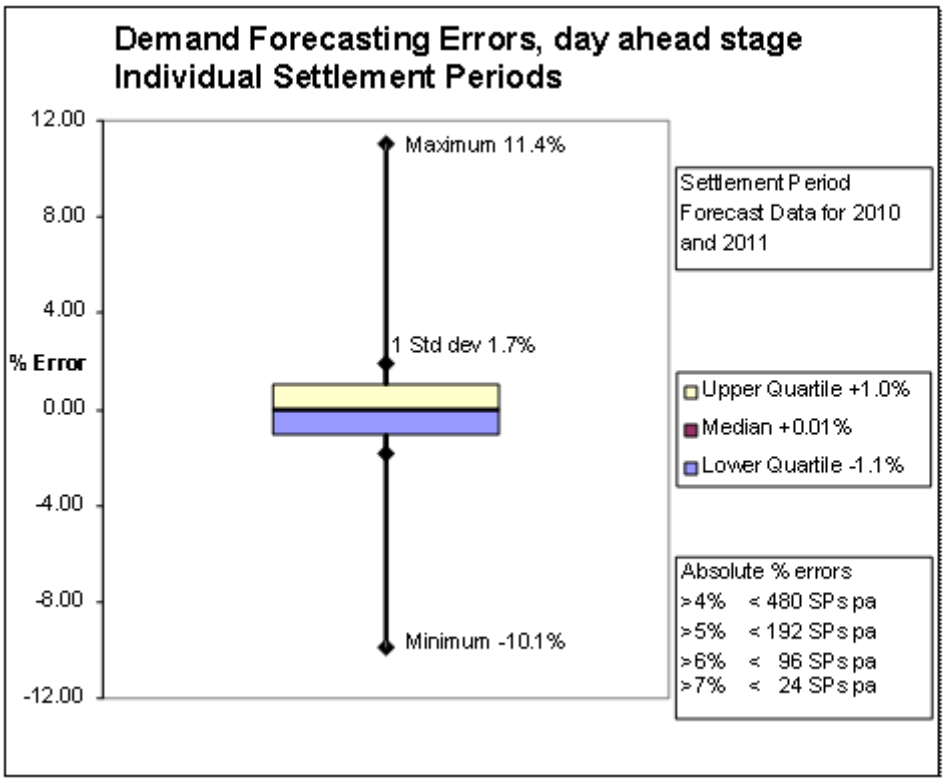
5 Accuracy of National Grid's Demand Forecasting



How to interpret this data

National Grid has analysed the accuracy of individual Settlement Period (SP) demand forecasts at the day-ahead stage against the actual out-turn demand, using 2 years of data.

The forecasting error is expressed as a percentage of out-turn demand.

The analysis shows that:

- Roughly half of all forecasting errors are over-estimates of demand and half are under-estimates;
- 50% of SPs have an error of no more than 1.1% (upper and lower quartiles);
- Maximum errors are in the order of 10-12%; and
- The frequency of 'big' errors is low, with no more than 24 SPs within a year showing errors in excess of 7%.

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6 Results of Research into Historic System Events

System event	Description	Workgroup's comments
Great Storm, 15/16 October 1987	News reports state hundreds of thousands of customers affected; some without power for > 2 weeks.[3]	Predates NETA. Had bigger impact on Distribution Systems than Transmission System.
London blackout, 28 August 2003	Lasted 37 minutes (18:26 to 19:00). Affected 476,000 customers. *Sources: BBC news article, Ofgem's Press Release and House of Commons Trade & Industry Committee's report.*	Part of system was de-energised, but no generation in affected area.
Birmingham blackout, 5 September 2003	Lasted 42 minutes from about 10:10. Affected ~200,000 customers. *Sources: as per London blackout above.*	-
Exceptional generation loss, 27/28 May 2008	Started at 11:34 on 27 May. Total generation loss of 1993MW within 3.5 minutes. ELEXON's analysis suggests this is equivalent to 4.7% of expected generation. *Source: National Grid's published report into the event.*	The loss of 4.7% of generation is similar to the proposed P276 5% Market Suspension Threshold. However, part of system was not de-energised/ islanded so therefore not comparable with a Partial Shutdown.

Workgroup's conclusions

At the Workgroup's request, ELEXON has researched the particular circumstances of various historic system events.

The Workgroup has concluded that these events do not offer any meaningful indication of the impact that a Partial Shutdown could have on BSC Parties' imbalance charges.

[3] It has been difficult to find statistics relating to this event. The customer numbers given in the table are based on news reports found through internet searches. Some ELEXON staff who were involved in the event have suggested that the initial number of customers without power was in the region of 4 million, although they believe that the affected parts of the Transmission System were quickly restored with any remaining blackouts being due to Distribution System damage.

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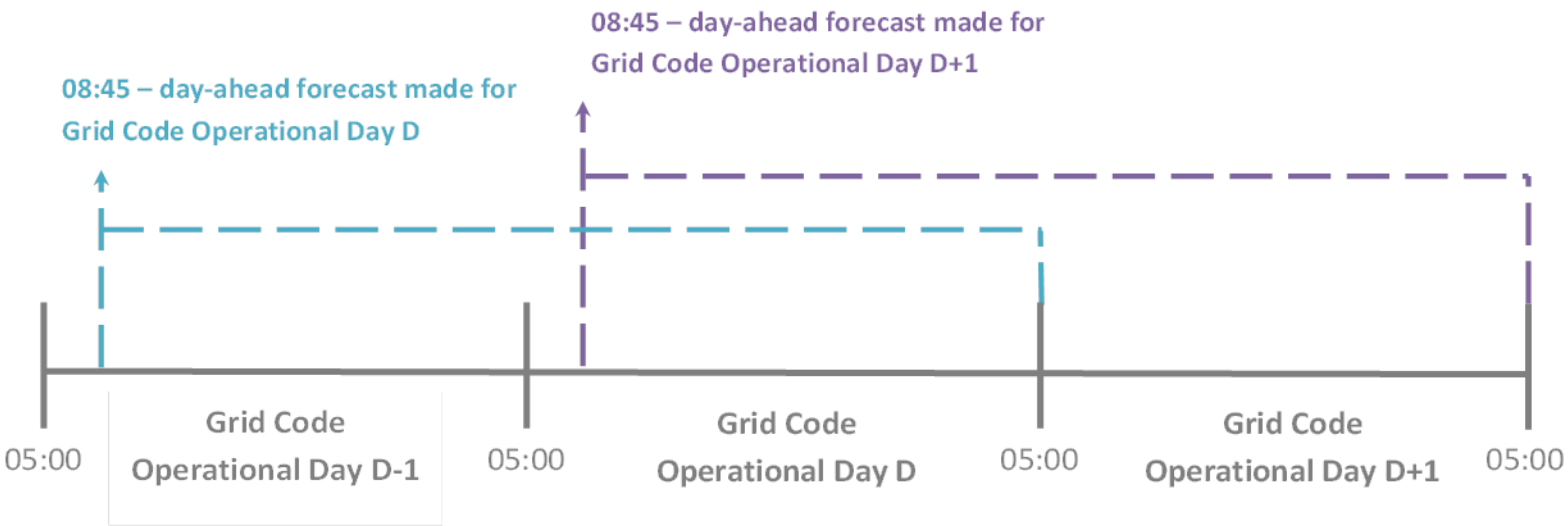
7 Duration Diagram for P276 Baseline Forecast Data

The intention of the P276 solution is to use an accurate pre-shutdown National Demand forecast as a 'business as usual' baseline for determining how much National Demand has been lost during the Partial Shutdown. During a prolonged Partial Shutdown, there will come a point when National Grid no longer has accurate pre-shutdown forecast data to determine how much National Demand has been lost.

National Grid's National Demand forecasts are made for a Grid Code Operational Day (05:00-05:00). In practice, the P276 threshold-monitoring process will use National Grid's pre-shutdown forecast made day-ahead at 08:45. Depending on when the Partial Shutdown occurs during Settlement Day D (00:00-00:00), there will therefore be between approximately 20 hours and 44 hours of baseline (pre-shutdown) forecast data available to National Grid. Under the proposed solution, the market will be suspended when this baseline forecast data runs out.



Currently, it is not possible for National Grid to produce National Demand forecasts further than one day ahead with the same degree of accuracy. This is due to the unavailability of accurate weather forecasts before that point. In the future, it is theoretically possible that improvements in weather forecasting could enable National Grid to continue monitoring the Market Suspension Threshold for longer. The proposed solution includes a 72-hour 'backstop' after which the market will still be suspended, even if National Grid continues to have accurate baseline forecast data and less than 5% of National Demand has been lost. This gives Parties certainty of the maximum time that the market can continue during a Partial Shutdown, reflecting the concerns of a majority of Workgroup members and Assessment Consultation respondents that Parties' may be unable to keep trading indefinitely during such an event.

How long will the market continue during a Partial Shutdown under P276?

The market will continue unless either:

- National Grid determines that 5% or more of National Demand has been lost;
- National Grid no longer has sufficient pre-shutdown forecast data to continue to determine accurately how much National Demand has been lost; or
- 72 hours have elapsed since the Partial Shutdown began,

whichever occurs first.

Section 3 of the main report explains the reasons for this solution.

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Purpose of this section

This section gives further details of the proposed P276 compensation arrangements.

You can find the Workgroup's reasoning in Section 4 of the main report.

Generators

The Workgroup considers that there are potentially four relevant categories of generator:

1) Generators which are Black Start Stations as defined in the Grid Code (i.e. which are registered under their bilateral agreement with National Grid as having a Black Start Capability, as defined in the Grid Code);
2) Generators without a Black Start Capability but who may have bilateral contracts with National Grid to otherwise assist in a Black Start situation;
3) Generators which are capable of a 'black start' but do not have a contract with National Grid to use this capability (i.e. they are not Black Start Stations with a contracted Black Start Capability as defined in the Grid Code); and
4) Generators without a Black Start Capability/contract.

However, in practice there are only two relevant determining factors for which generators receive what type of compensation under P276:

- Which generators are actually issued with black start instructions during the Partial Shutdown and which aren't; and
- Which generators are in the shutdown area and which aren't.

The table below summarises the relevant P276 compensation.

Which generators are compensated in a Partial Shutdown under P276?	Market Suspension Threshold met (market suspended)	Market Suspension Threshold not met (market continues)
Generators issued with black start instructions May be inside or outside shutdown area	Can claim black start compensation under BSC. Definition of black start instruction is unchanged from BSC's existing definition. Compensation is still determined as Avoidable Costs minus imbalance charges received (or any reduction in imbalance charges paid) as a result of complying with the black start instruction. Existing calculation is unchanged.	Can claim black start compensation under BSC. Definition of black start instruction is different, reflecting market continuation. Compensation is still determined as Avoidable Costs minus imbalance charges received (or any reduction in imbalance charges paid) as a result of complying with the black start instruction. Exact calculation is different, reflecting continuation of dual imbalance prices and contract positions.
Generators in shutdown area who don't receive a black start instruction	Contact positions suspended. Paid single imbalance price for any generation. Not eligible for BSC's black start compensation. Not eligible for CUSC's Interruption Payments.	'Short' due to shutdown and pay prevailing SBP for their imbalance. *Group recommends extending CUSC's Interruption Payments to these generators.*
Generators outside shutdown area who don't receive a black start instruction	Contract positions suspended. Paid single imbalance price for their generation. Not eligible for BSC's black start compensation. Not eligible for CUSC's Interruption Payments.	Can still generate and trade, with any imbalance exposed to prevailing SBP/SSP depending on their contract position. *Any interruption to their transmission access may be eligible for CUSC's Interruption Payments if these are extended to Partial Shutdowns where the market continues.*

The compensation provisions which apply to a Market Suspension Period under P276 are unchanged from the BSC's existing black start compensation provisions. The only difference is for Settlement Periods in which there is a Black Start Period but no Market Suspension Period. Except where stated, the process for submitting and determining claims remains unchanged from the existing process in BSC Section G3.3 and BSCP201.

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What if some Gensets at a Generating Plant are subject to a black start instruction but others aren't?

This hypothetical, simplified, example describes what happens to a single Generating Plant in the shutdown area which has two Gensets (each a separate BM Unit) as follows:

- **Genset 1** has a Black Start Capability. Had the Partial Shutdown not occurred, Genset 1 would have generated 250 MW. Because of the shutdown, it is initially tripped off the system such that its generation is tripped from 250 MW to zero. It then receives a black start instruction from National Grid (under BC2.9.1.2(e)(i) of the Grid Code) to use its Black Start Capability to generate 100 MW. This all occurs within the same Settlement Period.
- **Genset 2** has no Black Start Capability and isn't subject to any instruction from National Grid. It would have originally generated 750 MW but, because of the shutdown, is tripped to zero.

What is a...?

Genset?

A Generating Unit, Power Park Module or CCGT Module at a Large Power Station or any Generating Unit, Power Park Module or CCGT Module which is directly connected to the National Electricity Transmission System.

See Grid Code Glossary & Definitions.

Genset 1

The Lead Party will be able to claim black start compensation under the BSC for the difference in Genset 1's output which was caused purely by complying with the black start instruction. The relevant difference in its output for the purposes of compensation will therefore be a net increase in its Export of 100 MW in this example (because without the black start instruction its Export would have been zero). If the market is suspended, such that all prior contract positions for that Settlement Period are ignored, the Lead Party will be paid imbalance charges for this 100 MW Export at the single imbalance price, and this payment will be netted off the compensation paid. If the market and contract positions continue then the same principles apply, but the imbalance charge benefit to the Lead Party may be at SBP or SSP (or a combination of the two) depending on their overall imbalance position. If the Lead Party had a Metered Volume Reallocation Notification (MVRN) in place for Genset 1, then the imbalance charge benefit from complying with the black start instruction will depend on the Subsidiary Party's imbalance position and the proposed compensation calculation will take this into account (although the compensation is still paid to the Lead Party). The further worked examples in Section 9 explain in more detail.

Genset 2

If the market is suspended and a single imbalance price applies, the Lead Party will have no imbalance exposure for the reduction in Genset 2's Export from 750 MW to zero.

If the market is not suspended, the Lead Party (and/or any Subsidiary Party if an MVRN is in place for the BM Unit) will be exposed to the prevailing dual cash-out prices for Genset 2's imbalance. The level of exposure will depend on the original contracted position. The Lead Party could claim an Interruption Payment if the CUSC arrangements are amended to permit this.

Genset 2 will not be eligible for black start compensation under the BSC.

Suppliers

The Workgroup has asked ELEXON to consider whether it is possible, practical and/or appropriate to apply BSC compensation to Suppliers under a possible P276 Alternative solution.

The following is a copy of ELEXON's note to the Group, outlining its findings.

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Summary of findings

Having considered the issue, we suggest to the P276 Workgroup that:

- Partial Shutdowns and Demand Control raise similar questions when it comes to calculating the volume of demand lost by each Supplier. The P199 Modification Group[4] was not able to find a satisfactory mechanism for calculating the impact of Demand Control on Suppliers, and this calls into question the feasibility of including Supplier compensation in any P276 Alternative.
- Even if this technical issue could be solved, it is not clear that the BSC is the right place to compensate Suppliers for interruptions in their access to the Transmission System. All existing compensation arrangements for interruptions in access to the Transmission System are defined in the CUSC. It would facilitate a consistent approach if any extension of such compensation to Suppliers affected by Partial Shutdowns was also addressed in the CUSC.

What BSC-related losses do Suppliers incur in a Partial Shutdown?

If there was a Partial Shutdown of the Transmission System, but the market was not suspended in response, affected Suppliers would potentially be left out of pocket:

- They have bought power in the market (presumably at some sort of market price, although this could vary considerably depending on their hedging strategy), with the intention of selling it to customers (at the price set out in the customer's contract).
- Where those customers have lost their supply, the Supplier can no longer dispose of the power they purchased in the way they intended. In the short term (up to the 'wall' of Settlement Periods that have passed Gate Closure when the incident occurred) their only option is to take System Sell Price (SSP) for the surplus. Beyond the wall they may be able to improve on SSP by trading out their position in the market.

Any mechanism that compensates Suppliers for this must therefore include mechanisms for assessing:

- The volume (MWh) of load lost by each Supplier as a result of the Partial Shutdown; and
- A price (£/MWh) at which the Supplier should be compensated.

In order to shed some light on these two issues, it may be helpful to consider a previous Modification Proposal that sought to compensate Suppliers for energy they'd bought but couldn't sell: rejected Alternative Modification P199.

Relevant points from P199 & P199 Alternative

P199 was not primarily about compensating Suppliers. The key issues it sought to address were:

- Ensuring that the incentives on Suppliers remain appropriate as the risk of Demand Control increases (and that, for example, Suppliers are not left with perverse incentives whereby they benefit from Demand Control); and
- Ensuring that the costs of Demand Control (as a type of balancing action) are properly included in imbalance prices.

[4] P199 'Quantification of Demand Control in the BSC as instructed under OC6 (c), (d) & (e) of the Grid Code'.

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These issues don't appear to be directly relevant to Partial Shutdowns. However, the P199 Group did consider the question of how to calculate a Demand Control Volume for each Supplier, which does have direct parallels to P276.

Calculation of Demand Control Volume for each Supplier BM Unit

The solution agreed by the P199 Modification Group was as follows:

- **Step 1** – estimate the total volume of demand reduction (in each GSP Group and Settlement Period) caused by the Demand Control. The Modification Group discussed a number of possible approaches to this (see Appendix 5 to the P199 Assessment Report), but concluded that the most practicable approach would be for National Grid to provide its best estimate.
- **Step 2** – allocate the total volume (in each GSP Group and Settlement Period) between affected Suppliers. The Modification Group considered two approaches to this:
  - Option A - Allocating based on historic demand i.e. the total volume is shared out between Suppliers in proportion to their demand in the GSP Group in a historic reference period. This approach assumes that Demand Control affects Suppliers in proportion to their total customer demand in the GSP Group (and will produce erroneous Imbalance Charges if this assumption doesn't hold).
  - Option B - Allocating based on BM Unit profiling i.e. use historic data for each Supplier BM Unit to forecast what its demand would have been in the absence of Demand Control, and compare that to the actual Metered Volume to derive the Demand Control volume. The Group considered that this approach would not be practical, as forecasting Metered Volumes for Supplier BM Units with sufficient accuracy would require either an extremely complex algorithm or a resource-intensive manual process. The solution they developed was therefore based around Option A.
- **Step 3** – if this mechanistic allocation process led to an error in a given Supplier's share of the total volume, they would be able to make a Demand Control Reallocation Claim presenting evidence of the error, in order to have the volumes adjusted. A non-refundable £5,000 fee would apply (as a contribution to the cost of processing the claim, and to deter non-material claims).

Supplier compensation

P199 Proposed Modification treated the Demand Control Volume for each Supplier as a zero-priced Offer. So rather than compensating Suppliers, P199 Proposed removed the payment (at SSP) that they would otherwise have obtained.

P199 Alternative Modification addressed this by pricing the Demand Control Offers at Market Price (rather than zero). This ensured that Suppliers received some payment for the power that they had bought in good faith, but then couldn't sell as a result of Demand Control.

In both P199 Proposed and P199 Alternative the Demand Control Offers were treated as unpriced in the calculation of imbalance prices.

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Panel recommendation and Ofgem decision

The BSC Panel recommended rejection of P199 Proposed and Alternative, primarily because of the difficulties in allocating Demand Control volumes to Suppliers:

- The proposed method of allocating the Demand Control volume to Suppliers was inaccurate, and would lead to inaccurate imbalance charges; and
- The claims process (which allowed for correction of such errors) would be inefficient and expensive to administer.

Ofgem agreed with these views, and decided (on 3 August 2006) that both the Proposed and the Alternative should be rejected.

Possible approaches to Supplier compensation for P276

We believe that the problem of determining the volume of load lost by each Supplier during a Partial Shutdown is similar to that of determining Demand Control Volumes under P199:

- In each case, National Grid should be able to judge the total volume of demand lost (by comparing its own demand forecasts to Meter readings at the Transmission System boundary); but
- National Grid will not have the information required to determine how that total volume was allocated between Suppliers.

Because of these similarities, we believe that the high-level options for allocating volumes to Suppliers under any P276 Alternative would be similar to those considered under P199:

- A mechanistic process of allocating volumes based on historic demand;
- A process of allocating volumes based on profiling of historic data for each BM Unit; and/or
- A claims-based process that allows Suppliers to submit evidence on the appropriate volume for each BM Unit.

The fact that none of these P199 options were found to be satisfactory (and that P199 was ultimately rejected for this reason) suggests that it would be technically difficult to include Supplier compensation in any P276 Alternative.

We believe it is also questionable whether – even if these technical issues could be solved – the BSC would be the right place to define compensation for Suppliers whose access to the Transmission System is interrupted by a Partial Shutdown. All existing arrangements for compensating Users whose access to the Transmission System is interrupted are defined in the CUSC. It would therefore facilitate a consistent approach to compensation if any extension of such compensation to Suppliers affected by Partial Shutdowns was also addressed through a CUSC Modification.[5]

[5] We note Ofgem's comments in its P199 decision letter that "as outlined in previous decision letters, Ofgem has concerns with the concept of the BSC Panel determining compensation claims". One of the previous decision letters referred to by Ofgem is for P80 'Deemed Bid/Offer Acceptance for Transmission System Faults'. In its P80 decision letter, Ofgem states that "In general, Ofgem considers that transmission related issues, such as access arrangements to the Transmission System and compensation following faults on the Transmission System, naturally belong within the governance structure of the CUSC and/or the transmission Charging Methodologies… It is Ofgem's view that compensation following disconnection from the Transmission System relates to NGC's transmission use of system arrangements and hence should be set out in the CUSC or NGC's Charging Methodologies and Statements rather than under the BSC".

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9 Worked Examples of P276 Compensation Algebra

Purpose of this section

This section provides worked examples of the proposed black start compensation algebra for Settlement Periods which fall within a Black Start Period but not within a Market Suspension Period.

You can find the proposed algebra in Attachment B.

P276's amended algebra for black start compensation

BSC Section G3.3.2 allows the Lead Party of a BM Unit which is given a black start instruction to claim compensation equal to an amount (A-B), where:

- A is the amount of Avoidable Costs incurred as a result of complying with the black start instruction; and
- B is the imbalance charges received (or the reduction in the imbalance charges paid) as a result of complying with the black start instruction.

Currently, G3.2.2 includes algebra for calculating the amount 'B' in the case where the market is suspended. But under P276 it may also be necessary to calculate 'B' when the market continues to operate.

This introduces additional complexities as follows:

- There will be two imbalance prices rather than one, and the imbalance price that applies to a particular Lead Party will depend upon whether their imbalance position is 'long' or 'short'; and
- MVRNs will be taken into account in Settlement, and therefore the black start instruction may affect the imbalance charges of one or more Subsidiary Parties (rather than, or in addition to, the Lead Party).[6]

The following examples illustrate how the proposed legal text addresses these complexities.

Example 1 – Black start instructions issued to two BM Units with the same Lead Party

Consider the case of a Lead Party who received black start instructions for two separate BM Units on their Production Account. In each case, the black start instruction was to increase output by 200MWh (i.e. $BSCQ^{n}_{ij}$ = 200MWh). The Lead Party's Production Account was 150MWh long (i.e. $QAEI_{aj}$ = 150MWh), and the Lead Party has now submitted compensation claims in respect of both BM Units.

If neither of the two black start instructions had been issued, the Production Account would have been 250MWh short rather than 150MWh long, and the Lead Party would have had to pay 250MWh*SBP_j of imbalance charges rather than receiving 150MWh*SSP_j of imbalance charges.

Therefore the total value of 'B' (summed across the two claims) must be:

$$\text{Total Imbalance Saving} = 250\text{MWh}*SBP_j + 150\text{MWh}*SSP_j$$

One possible approach to calculating 'B' would be to calculate the total imbalance saving and then apportion it between the two claims. However, this would introduce a risk of unnecessary delay, as neither claim could be settled until the black start compensation volume had been determined for both.

[6] Where the Lead Party has an MVRN to transfer 100% of a BM Unit's output, then only the Subsidiary Party will incur imbalance charges. If the MVRN is for a different percentage or a fixed volume of output, then both the Lead Party and Subsidiary Party will have an imbalance exposure as a result of the black start instruction.

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In order to avoid this risk, the proposed legal takes a different approach that allows sequential processing of claims. The value of 'B' for each claim is defined as the reduction in imbalance charges from complying with that black start instruction, compared to a baseline that takes into account any previously-processed claims.

In the example above, the amount 'B' for the first claim to be processed will be calculated as follows:

- $BSCAEI^{(n-1)}_{aj}$ is the value of Account Energy Imbalance Cashflow taking into account this black start instruction, but excluding any previously-processed claims (i.e. black start instructions for which the Panel has previously determined a black start compensation volume). In this case there are no such previously-processed claims, and therefore $BSCAEI^{(n-1)}_{aj} = CAEI_{aj} = -150MWh * SSP_j$.
- $BSCAEI^{n}_{aj}$ is the value of Account Energy Imbalance Cashflow excluding both this black start instruction and any previously-processed claims. In this case there are no previously-processed claims, but the Account Energy Imbalance Volume excluding the current claim is -50MWh, and therefore $BSCAEI^{n}_{aj} = 50MWh * SBP_j$.
- The amount 'B' for this claim is therefore $50MWh * SBP_j + 150MWh * SSP_j$.

When the second claim is processed subsequently, the amount 'B' will be calculated as follows:

- $BSCAEI^{(n-1)}_{aj}$ is the value of Account Energy Imbalance Cashflow taking into account this black start instruction, but excluding the previously-processed claims. In other words, $BSCAEI^{(n-1)}_{aj}$ for the second claim is equal to $BSCAEI^{n}_{aj}$ for the first claim – i.e. $50MWh * SBP_j$.
- $BSCAEI^{n}_{aj}$ is the value of Account Energy Imbalance Cashflow excluding both this black start instruction and the previous one – i.e. $BSCAEI^{n}_{aj} = 250MWh * SBP_j$.
- The amount 'B' for the second claim is therefore $200MWh * SBP_j$.

In effect, this method allocates the total amount 'B' to individual claims on a 'first come first served' basis. The amount allocated to any particular claim depends on the order in which they are processed; but the total amount across all the Lead Party's claims is the same regardless of the order of processing.

Example 2 – Black start instructions issued to two BM Units with different Lead Parties but the same Subsidiary Party

This example has the same BM Units and black start instructions as Example 1, but with different Parties involved:

- Each BM Unit has a separate Lead Party;
- Both Lead Parties MVRN 100% of their output to the same Subsidiary Party, with the result that the Lead Parties themselves have no imbalance exposure; and
- The Subsidiary Party has the same imbalance exposure as the Lead Party in Example 1; i.e. their Account Energy Imbalance Volume is 150MWh, but would have been -250MWh if the black start instructions had not been issued.

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Because the legal text takes into account the imbalance position of Subsidiary Parties as well as Lead Parties, the calculation of the amount 'B' will give the same results as Example 1:

- For the first claim processed, 'B' will be 50MWh * SBP_j + 150MWh * SSP_j.
- For the second claim, 'B' will be 200MWh * SBP_j.

Note that, because it is the Lead Parties who make the compensation claims, their Avoidable Costs 'A' will be adjusted up or down to reflect imbalance charges incurred by the Subsidiary Party. If the Parties involved do not believe this is appropriate they may wish to make their own arrangements (in the contracts associated with the MVRN) to redistribute funds appropriately.

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10 Workgroup Information

Workgroup's Terms of Reference

Area	Specific question set by Panel
Threshold	What is the appropriate BSC trigger/threshold for suspending the market following a Partial Shutdown?
	How big/severe should a shutdown be before the market is suspended and why? This may require analysis (e.g. of the cash-flow disruption of suspending, versus continuing, the market). The Workgroup should consider any effect on the timely restoration of the Transmission System.
Compensation arrangements	What BSC arrangements, if any, are required to compensate the following participants for a Partial Shutdown in which the market is not suspended? • Generators who receive black start instructions from National Grid • Other generators in the affected area who are prevented from generating by the incident; and • Suppliers in the affected area who lose demand as a result of the incident. (Development of some of these arrangements could require an Alternative Modification.)
	How would any compensation interact with imbalance charges and with compensation arrangements under other codes (e.g. in the CUSC)?
Grid Code impact	Should a small, localised shutdown in which the market is not suspended still be called a Partial Shutdown under the Grid Code?
	Is a new Grid Code definition of 'Local Shutdown' needed?
	Is there any other impact on the Grid Code?
Benefits to System Operator	How will P276 help National Grid in its role as System Operator?

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Assessment Procedure timetable

Activity	Date
Panel submits P276 to Assessment Procedure	13 October 2011
Workgroup Meeting 1	24 October 2011
Initial analysis and actions completed	25 October – 13 December 2011
Workgroup Meeting 2	14 December 2011
Further analysis and actions completed	15 December 2011 – 28 February 2012
Workgroup Meeting 3	29 February 2012
Consultation document produced	1 March – 28 March 2012
15WD Assessment Consultation	29 March – 20 April 2012
Workgroup Meeting 4	26 April 2012
Assessment Report produced	27 April – 3 May 2012
Assessment Report submitted to Panel	4 May 2012
Panel considers Assessment Report	10 May 2012

Workgroup membership and attendance

Name	Organisation	24/10/11	14/12/11	29/02/12	26/04/12
Members					
Adam Lattimore	ELEXON (Chair)	✓	✓	✓	X
Kathryn Coffin	ELEXON (Lead Analyst)	✓	✓	✓	✓
Ben Smith	National Grid (Proposer)	✓	X	X	X
Nick Sargent	National Grid (Alternate)	X	✓	✓	✓
Bill Reed	RWE	X	✓	✓	✓
Gary Henderson	IBM for Scottish Power	✓	✓	☎(part)	✓
Garth Graham	SSE	✓	☎	✓	X
Martin Mate	EDF Energy	✓	✓	X	✓
Esther Sutton	E.ON	✓	☎	X	X
Lisa Waters	Waters Wye Associates	X	X	✓	X
Attendees					
Steve Francis	ELEXON (technical support)	X	✓	X	X
John Lucas	ELEXON (technical support)	Part	X	✓	✓
Nilton Green	National Grid (technical support)	✓	X	X	X
Angela Hodgson	National Grid (technical support)	X	✓	✓	✓
Wil Barber	Ofgem	✓	X	X	X

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