Power Park Module Signal Best Practice Guide

for Intermittent Generation

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Version 3.0

Contents

Version History	Content Updates
v1.0 July 2019	Initial release
v2.0 March 2020	Quality standard and impact of inaccurate signalling
v2.1 March 2020	Minor updates
v3.0 May 2021	Updates to accuracy standard and inclusion of K-factor. Other updates following internal review

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Overview

Introduction

This Power Park Module (PPM) guidance document is aimed at intermittent generators in the Balancing Mechanism submitting operational data to National Grid Electricity System Operator (ESO). It intends to explain current control room operations in relation to intermittent generation and provide clarity of best practice for submitting operational data. It is important that agreed best practice evolves as industry understanding develops and, as such, the content of this document may be reviewed to appropriately reflect such developments.

The ESO is actively trying to improve the efficient use of intermittent generation to balance the system and is now using the Power Available (PA) signal to enable accurate use of the real-time instructed services including Mandatory Frequency Response (MFR) and positive reserve holdings. Further benefits of PA such as improved forecasting accuracy could also open more opportunities for intermittent generation to participate in response and other reserve services.

The information explained in this document is derived from the Grid Code. Please note this is an attempt to clarify understanding and promote discussion and actions to enable the benefits of proposed changes faster. **The Grid Code remains, as always, the authoritative document in case of any contradictions.**

The purpose of this document is to explain the process of how the ESO balances the system and how Power Park Modules should effectively participate in this. The document explores the process the ESO follows to commit resources and balance the system, the data required of intermittent generation and how a Power Park Module should behave practically in various scenarios.

The document is structured by first introducing the data that is required to be provided by Power Park Modules to the ESO in section 2, before explaining in detail how this should practically be submitted under different operating conditions in section 3. Definitions are included in Appendix A.

Drivers for Change

The ESO's ambition is to be able to operate a zero-carbon electricity system by 2025. This is essential for the UK to meet its legislated net-zero targets. As the amount of intermittent generation on the system increases and thermal plant that was traditionally relied on for energy balancing and response declines, there is an increasing need to procure balancing services from new sources. The Power Available signal supports the instruction of real-time instructed response and reserve services as an addition to existing Grid Code parameters to better reflect the current weather-based capability of PPMs. Power Available, alongside improvements in other operational signalling, such as submissions of Physical Notifications (PN), will begin to enable the ESO to fully utilise intermittent generators to provide response and reserve services. This is a key enabler in our zero-carbon operation ambition.

PPMs with connection agreements after 1 April 2016 are required to provide PA signals under the Grid Code. Wherever possible, the PA signals should comply with the accuracy standard, which is discussed later in the document. At the time of publication, data quality against the standard appears mixed. The ESO is working with wind generators to resolve this.

Inaccurate signalling, whether of the PA signal or other operational signals like PNs, creates a challenge for the control room as the engineers are required to take actions to balance the system and with incorrect data. Incorrect data can lead to sub-optimal decisions being taken, for example too much or too little response capability being held.

Balancing Mechanism

The wholesale market is based on trades between generators and suppliers. This market is designed to self-balance and enables energy to be traded on a contractual basis. However, the resulting market position will not truly reflect the actual generation or demand position at any one time. Factors such as the weather, generator outages or unexpected changes in demand can all cause discrepancies. It is the ESO's responsibility to ensure that generation and demand are balanced in real-time.

The Balancing Mechanism is the primary tool the ESO uses to ensure that supply and demand can be continuously matched or "balanced" in real time. As the market moves towards real-time it is important to be able to assess levels of generation against forecast demand and take any actions to correct an imbalance.

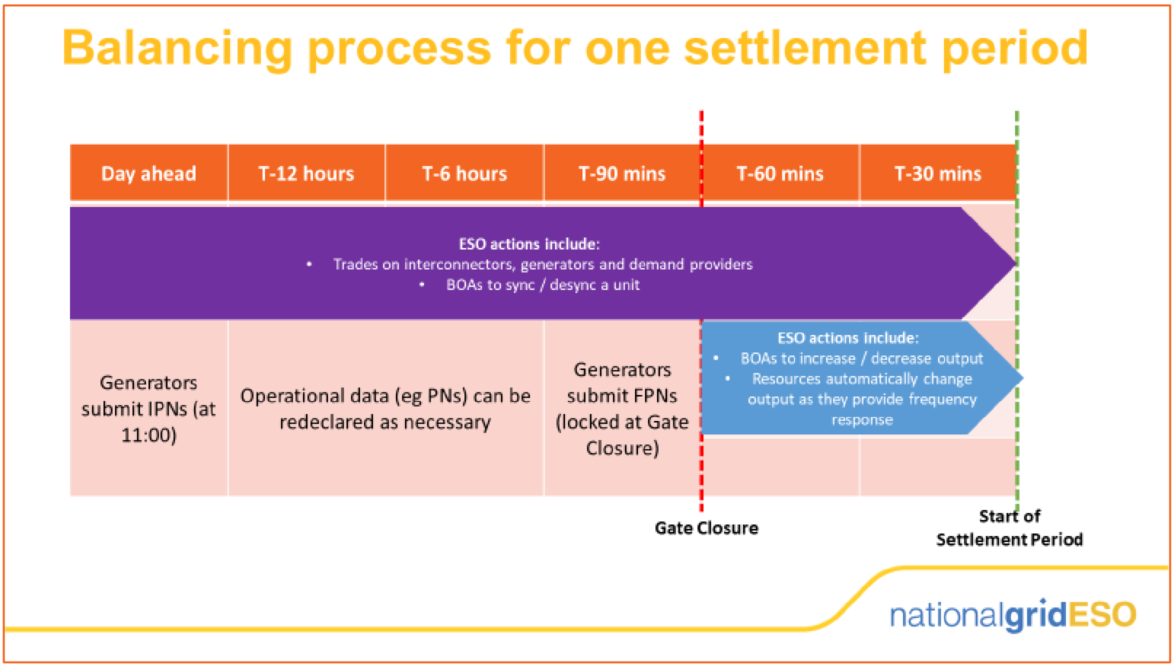
Each day is divided up into 48 half-hourly Settlement Periods. Various pieces of operational data (discussed in section 2) can be submitted any time up to 60 minutes before the start of the settlement period, which is called Gate Closure. At Gate Closure, most of this data is "frozen" allowing time for the control room to calculate any necessary adjustments and execute actions. For example, for the Settlement Period running from 11:00 to 11:30, Gate Closure is at 10:00. At 10:00, data applicable to the period 11:00 to 11:30 cannot be changed, except in limited circumstances, ensuring there is a 60-minute period of fixed market data.

All market participants are required to inform the ESO of their intended physical output position. Initial Physical Notifications (IPNs) are submitted at 11:00 at the day ahead stage. These are continually updated until Gate Closure when they become the Final Physical Notifications (FPNs). Market participants are also required to indicate the operational Maximum Export Limit (MEL) of their unit during each settlement period. The summation of these notifications, along with estimates of demand forecasts and other relevant information, inform the ESO as to any likely subsequent activity that the ESO will need to enact to maintain the supply and demand equilibrium.

National Grid ESO is the instigator and sole counter party to all transactions that take place in the Balancing Mechanism. Participation, which is optional, involves participants submitting 'offers' (proposed trades to increase generation or decrease demand) and/or 'bids' (proposed trades to decrease generation or increase demand). The prices and volumes of each of these submissions indicate the value that participants have placed on moving from their Final Physical Notification (FPN) declared at Gate Closure. The instruction to move a participant from one position to another must conform to the dynamic characteristics of the BM Unit as declared by the party at gate closure. The ESO is obligated to accept these bids and offers in an economic and efficient manner and compensation for participants is on a pay-as-bid basis.

Figure 1 shows an overview of the balancing process for one settlement period.

Figure 1: Balancing process for one settlement period



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Data Requirements for Power Park Modules

Data Requirements Summary

This section is a summary for Power Park Module operators, explaining what data is required by the ESO to enable optimal utilisation of Intermittent Generation.

Below are the data sets required from PPMs that this best practice guide will focus on. These signals dictate the control room's actions when balancing. All units are in MWs.

BM data submissions	
Maximum Export Level (MEL)	The sum of the maximum operational output of all Power Park Units in service over time, excluding weather effects. *(The MEL definition for PPMs was modified by GC0063 and is different to other types of generation)*
Stable Export Level (SEL)	The lowest level of generation possible without de-sync. *(Most modern wind farms can operate with turbines synchronised with zero power output)*
Physical Notification (PN)	The most accurate forecast of MW output at Grid Entry Point Meter.
Registered Capacity	The normal full load capacity of the Power Park Module at the User System Entry Point.
Operational metering signals	
Power Available (PA)	The MW output the Power Park Module could generate at the **Grid Entry Point Meter** if National Grid ESO instructed it to operate at full output based on the renewable energy source available at that time. This signal should be consistent with the MW value at Grid Entry Point Meter, unless output is altered by an instruction or by providing a service such as Frequency Response. Signals to have a 1 second update rate or better (for further information on the refresh rate requirements please see the Power Available Data Specification Tables in Section 3)
Metered Output (MO)	The active power (MW) output fed onto the system and measured at the Grid Entry Point. Signals to have a 1 second update rate or better.

The information below is also submitted to National Grid ESO by all generators. It is also important for control room operations but will be focused on less in this document.

Other Operational metering signals	
Strength and direction of non-controllable power source (applies to intermittent generation)	For wind generators, this is wind speed and wind direction in m/s and degrees from North in a clockwise direction. The detail of these parameters will vary for other technology types such as solar and tidal to reflect the relevant power source. Signals to have a 5 second update rate or better.
Mvar power output derived from settlement metering	This is the reactive power (in Mvar) fed onto the system. Signals to have a 1 second update rate or better.
Voltage (kV)	Voltage metering derived from user's voltage transformer. Signals to have a 1 second update rate or better.
Frequency (Hz)	Frequency signal derived from user's plant. Signals to have a 1 second update rate or better.
Other Generator parameters used for system balancing	
Notice to Deviate from Zero, NDZ	Should be the shortest possible time in minutes it would take the Power Park Module to start generating from a shutdown *(typically 2 minutes).*
Minimum Non-Zero Time, MNZT	Should be the shortest possible time in minutes the Power Park Module can generate before reducing output back to zero *(typically 2 minutes).*
Minimum Zero Time, MZT	Should be the shortest possible time the Power Park Module can generate zero MWs before increasing generation again *(typically 2 minutes).*

This list is a high-level summary and is not exhaustive – refer to the Grid Code for the full list of operational parameters that must be provided to the ESO.

The requirements for Power Available were introduced under Grid Code Modification GC0063. Full details of this workgroup are detailed in the Report to Authority[1].

[1] All documents relating to GC0063: Power Available can be found using the following link: https://www.nationalgrideso.com/codes/grid-code/modifications/gc0063-power-available

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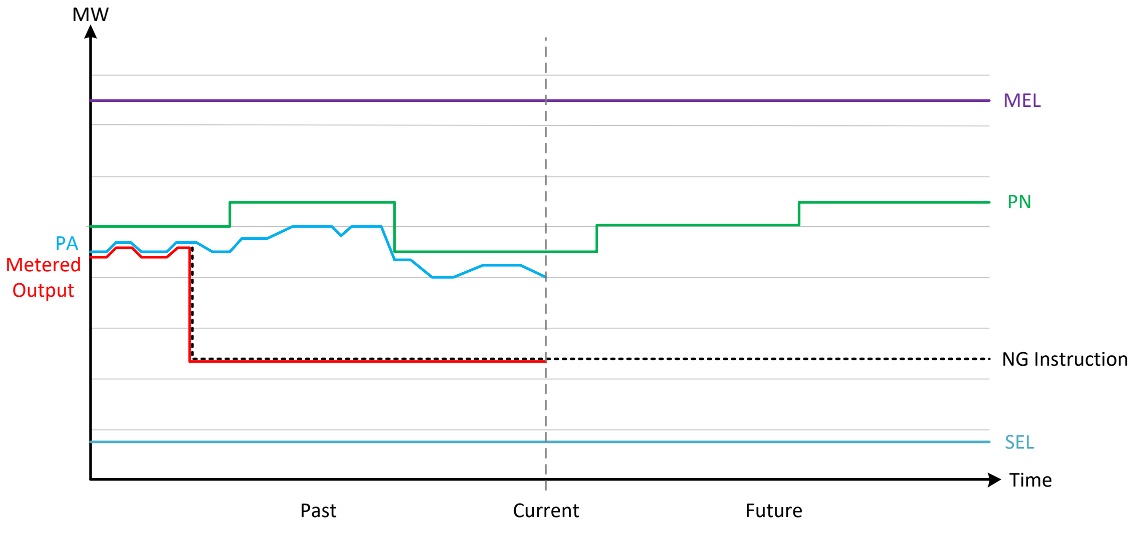
Operational Best Practice for Intermittent Generation

Operational Data Guide

This section details further the information presented in Section 2. The data discussed in this section are PN, MEL, SEL and PA

Figure 2 shows the data required for a wind unit to be effectively utilised by National Grid ESO.

Figure 2 Data Related to a Power Park Module



Power Available (PA) – The MW output that would be delivered if the Power Park Module was not instructed to de-load by NG

Physical Notification (PN)

For each BM Unit, data that describes the BM Participant's best estimate of the expected input or output of Active Power of a BM Unit and/or (where relevant) Generating Unit, at the Grid Entry Point or Grid Supply Point. For intermittent generators, this is often derived from a forecast that considers (amongst other things) weather, turbine availability and commercial position. For all generators, the PN must be developed in line with good industry practice.

PN data can be submitted at up to 1-minute granularity to reflect forecast Active Power output from PPMs. Averaging data across each settlement period should be avoided as it results in control system step-changes. ESO control room systems graphically display this data as seen in Figure 2.

It is crucial that this PN data is accurate as all instructions and services are costed from PN. Currently, wind units are not penalised for imbalance against their PN as long as it was made in line with good industry practice. This may change in the future.

The PN data can be resubmitted at any time but cannot be changed after Gate Closure. All ESO instructions (also known as BOAs) start from and finish at the PN. The cost of this volume is then paid to the relevant units.

Maximum Export Limit (MEL)

The Grid Code definition of MEL is described in Grid Code section BC1.A.1.3.1 and also included in Appendix A. The definition of MEL for PPMs was modified by GC0063 and is different to other types of generation. For intermittent generation, the MEL is simply the maximum MW output that would have been delivered onto the grid if the variable fuel source was optimal for generation. Any technical limitations and Power Park Units out of service should be considered and the MEL reduced accordingly. This includes wind units unavailable due to over-speed shut-down (cut-outs) for a period of more than 15 minutes.

MEL should be readjusted as conditions change in real time to reflect plant availability, such as Power Park Units being taken out of service for operational or maintenance reasons.

For frequency response effectiveness, it is important to know how many turbines are in service. Currently National Grid ESO use the MEL together with the Registered Capacity of the PPM to estimate number of turbines in service (see K-factor below).

Stable Export Limit (SEL)

The SEL of an Intermittent Generator is the same for conventional generation and is simply the lowest MW Output at which the unit can generate in a stable condition without having to reduce MW output to zero.

Stable Export Limit (SEL) expressed in MW at the Grid Entry Point or Grid Supply Point or GSP Group, as appropriate, being the minimum value at which the BM Unit can, under stable conditions, export to the National Electricity Transmission System.

Power Available (PA)

Power Available real-time potential MW output that a Power Park Module could generate allowing for current weather conditions and available Power Park Units. It is required by the ESO control room to balance the system using generation from intermittent generators such as wind, solar, and wave.

Providing the ESO with Power Available data is part of the operational metering requirements for Power Park Modules. It is additional to the data requirements mentioned above and should be sent continuously to the ESO as an analogue signal via the SCADA communication link.

Although generators are required to provide operational data such as PN, the actual output of a PPM may not reflect this. Wind units may over or under generate due for commercial reasons or because the weather was different from forecast. They may also be subject to instructions (BOAs) from the ESO.

During those periods, the ESO uses the Power Available signal to calculate the amount of “headroom” available. This is the difference between what the unit is producing and what it could produce. The headroom is used by the control room to:

- Provide real-time visibility of what a PPM will return to after a BOA, which is particularly useful for managing constraints
- Determine how much frequency response and reserve a unit could provide, both in real-time and, through blending with forecasts, into the short-term.

K-factor

If a PPM has a reduced maximum output due to an individual Power Park Unit (eg wind turbine) being out of service or operating at a reduced rate the amount of available response will be impacted. To take this into consideration when calculating response for PPMs, the amount of response is factored down by using a performance factor or more commonly referred to as the “K-factor”.

As PPMs do not currently advise the ESO of individual unit availability, the K-factor is therefore based on MEL which is the maximum output that the PPM can provide taking into account any physical restrictions of PPUs and not taking into account climatic conditions. Which is then divided by the registered capacity of the PPM giving a factor between 0 and 1.

$$K = \frac{Maximum\ Export\ Limit}{Registered\ Capacity}$$

The available response for a PPM is deduced using a K-factor capping methodology.

For each type of response (Primary, Secondary and High), the maximum response capacity for each is multiplied by the K-factor to return a cap for each. After calculating the de-load and interpolation of the Response matrix for that particular PPM, any response values which are then returned from the response matrix below the cap are unaltered. Any capabilities returned at or above the cap are simply capped.

Power Available Data Specification

Constraints	Note
PA data must have a 1 second update rate or better	As part of the operational metering requirements, PA must be sent continuously to the ESO as an analogue signal via the SCADA communication link. To align with Operational Metering refresh requirements and best practice the long-term aim is to achieve a PA signal with a 1 second refresh rate. The requirement for a PA signal and the associated refresh rate is currently specified in Schedule 2 of Appendix F5. For all new sites a 1 second refresh rate is specified in the standard F5 template and we are confident that the latest equipment is capable of achieving this. Some existing sites are equipped with older equipment that may be incapable of measuring accurately at the required 1 second interval. There is no intention from the ESO to update the existing bilateral contracts to mandate a 1 second refresh rate on these existing sites at present. It should, however, be noted by market participants that a 1 second refresh rate of an accurate PA signal is much preferred by control room operations as this data will be used in the decisions taken to support system balancing.
PA must be precise to the nearest MW or better.	Small PPMs <50MW may benefit from providing PA to 2 decimal places
A PA Status signal should also be sent alongside the PA MW value advising if the PA data is "OK" or "Unreliable".	If the PPM is aware that the PA data may be unreliable for whatever reason, then the status should be reflected accordingly.
PA must be equal to Metered Output unless the PPM is constrained (within the agreed tolerance)*	Unless output is constrained by an ESO instruction such as a BOA or by providing a service such as Frequency Response, PA should be the same as the MW value at the Grid Entry Point Meter (Metered Output) as all available power is being generated.
PA must be less than or equal to MEL (within the agreed tolerance)*.	PA should never exceed the value of MEL as this would indicate that more power is available than the maximum that can be generated under optimum weather conditions. This applies if MEL is submitted correctly. However, the MEL should not cap the PA calculated value. This is to prevent inaccurate MEL making PA inaccurate.

***All Power Available signals must be accurate; however, an agreed tolerance / acceptable error is defined in the Power Available Quality Standard below.**

Power Available Quality Standard

Analysis undertaken by Strathclyde University[2] has supported the ESO's development of a Quality Standard methodology for determining the acceptable error tolerance for Power Available data and the implications for submitting inaccurate PA.

The Quality Standard needs to satisfy the three key success criteria[3]:

- Reflect the Operational needs of the ESO
- Be attainable by wind farms under existing technological constraints
- Be pragmatic, practical and easy to understand

The resulting Quality Standard has been assessed as meeting these aims.

Accuracy standard

The accuracy standard depends on whether or not the unit is in a BOA.

Unit not in a BOA

For a unit not in a BOA, the Power Available should be equal to the Metered Output, up to a tolerance:

$$|Round\ (PA) - Round\ (MO)| \leq Tolerance$$

where Round() is the nearest integer function and Tolerance is currently **1.5% of registered capacity**, but is configurable and can also be a MW figure.

Unit in a BOA

For a unit in a BOA, the Power Available should be greater than or equal to the Metered Output, up to a tolerance

$$Round\ (PA) \geq Round\ (MO) - Tolerance$$

where tolerance is currently **1.5% of registered capacity**, but is configurable and can also be a MW figure.

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[2] Browell, J., Stock, A., & McMillan, D. (2019). *Recommendation for the Evaluation of Wind Farm Power Available Signal Accuracy*. Glasgow: University of Strathclyde.

https://pureportal.strath.ac.uk/en/publications/recommendation-for-the-evaluation-of-wind-farm-power-available-si

[3] https://pureportal.strath.ac.uk/en/publications/power-available-signals-zero-carbon-eso-and-new-revenue-streams

Rounding

The Power Available and Metered Output values are rounded because control room screens do not currently display floating point numbers. We do not believe this adversely affects the accuracy calculation.

What determines an "inaccurate" reading?

A PA signal is deemed "inaccurate" when the above conditions are not met.

As the PA signal is refreshed on a second by second basis it would be impractical to keep flagging inaccurate signals on this basis. Therefore, a temporal element is included in the inaccuracy calculation to produce a more manageable and meaningful result.

The PA signal must have been flagging as "inaccurate" based on the criteria above continuously for 5 minutes to trigger a change to that site's status on the ESO control room advisory screens from "reliable" to "unreliable".

When absolute error from the PA signal is continuously within tolerance for 1 minute then the site's status on the ESO control room advisory screens will be returned to "reliable".

As the ESO control room start to use PA in earnest this accuracy standard may need to evolve however we will endeavour to fully consult impacted stakeholders before a change and provide reasoning behind such a change.

What is the impact of having an "inaccurate" PA signal?

Control Room engineers will be advised not to arm sites with unreliable PA statuses for Mandatory Frequency Response or use these sites to hold positive reserve. This means that the site is unlikely to be called for Mandatory Frequency Response, but it is not impossible. It also means these sites will not be deloaded purely to hold positive reserve. The PA quality standard acts as a guide rather than a binding constraint on control room operations. Nonetheless wind farms should always aim to provide an accurate PA signal.

Intermittent Generation Behaviour

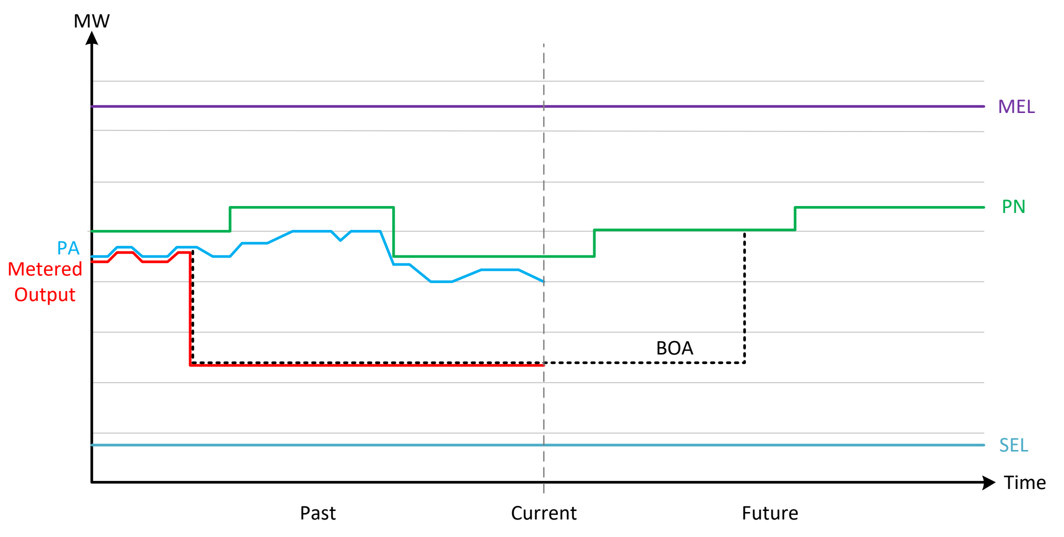
Behaviour During BOA

During the BOA period the Power Park Module must follow the new profile CCL as created by the BOA instruction. In other words, the MW Meter output will increase or decrease to follow the BOA target.

Additionally, during the BOA period the PA MW values sent to National Grid ESO must remain the calculated potential output and be recalculated continually. For clarity, this PA MW value should be the MW the Power Park Module would be generating if it was not deloaded to follow the BOA.

Deloading should be done by reducing output evenly across all turbines to maintain predicted response capability unless a different approach was approved and used during connection testing to derive the MSA response tables.

Figure 3: PA behaviour during BOA



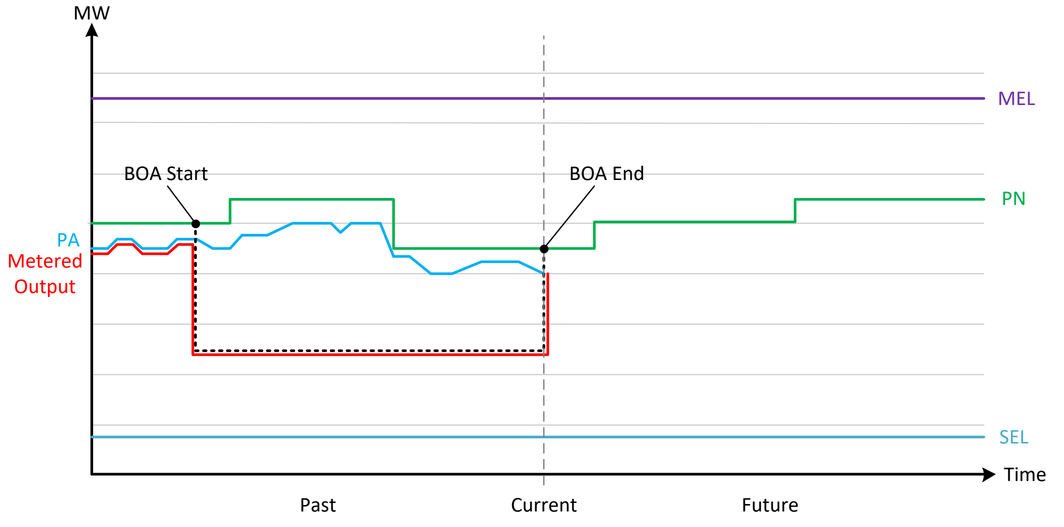
Power Available (PA) – The MW output that would be delivered if the Power Park Module was not instructed to de-load by NG

Behaviour at the end of a BOA

National system frequency must be tightly controlled for the ESO to meet its legal obligations. An imbalance between generation and demand of 300 MW can put us at the edge of our operational limits. It is therefore very important that the Power Park Modules return to full output at the exact minute the BOA instruction ends, following their declared ramp rate. Currently many existing Power Park Modules have a manual process to set the set points of the modules to follow the instruction and, as such, the return time is not always at the end of the BOA as expected.

At the end of the BOA, the MW output quickly returns to the PN level, or PA if that is less than PN.

Figure 4: PA behaviour at the end of BOA



The Metered Output returns quickly to the PA level after the BOA ends

Behaviour During Frequency Response

All Generating Units subject to the EU Code including Power Park Modules are required to operate in Limited Frequency Sensitive Mode unless instructed to Frequency Sensitive Mode (i.e. free governor action). When the National Grid ESO requires further frequency response, additional Generating Units will be instructed to Frequency Sensitive Mode by receiving a ‘code MF’ instruction (note: different contracts can have different codes such as MFA, MFD etc). The ‘code MF’ instruction is sent to trigger mandatory frequency response and commercial response for BMUs.

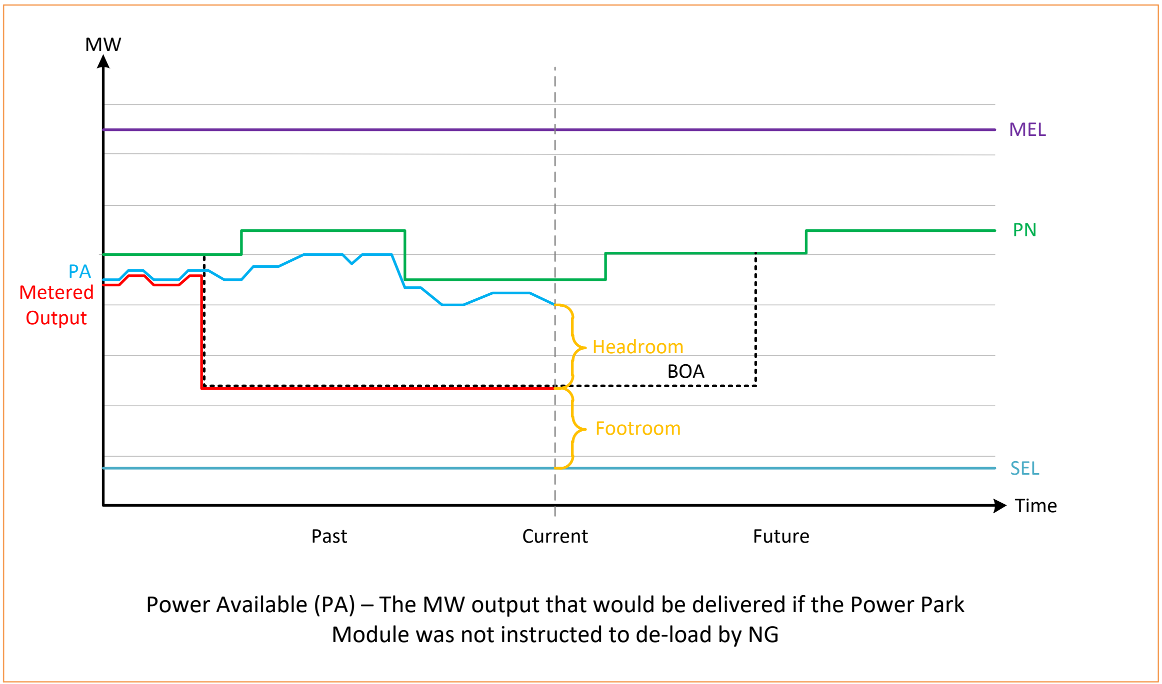
During operation in Frequency Sensitive Mode, the Power Park Module must change output in relation to system frequency, reflecting the frequency response capability curves as tested and included in the Mandatory Services Agreement.

If the national system frequency is higher than 50Hz the Power Park Module will deload; if the national system frequency is lower than 50Hz the unit will increase output.

Note that the Power Park Module will only upload if it was not at full output (PA) before the national frequency fell below 50Hz.

At all times the PA MW value should remain what the Power Park Module would be generating if it was at full output, not following a BOA instruction or providing frequency response.

Figure 5: PA behaviour during Frequency Response

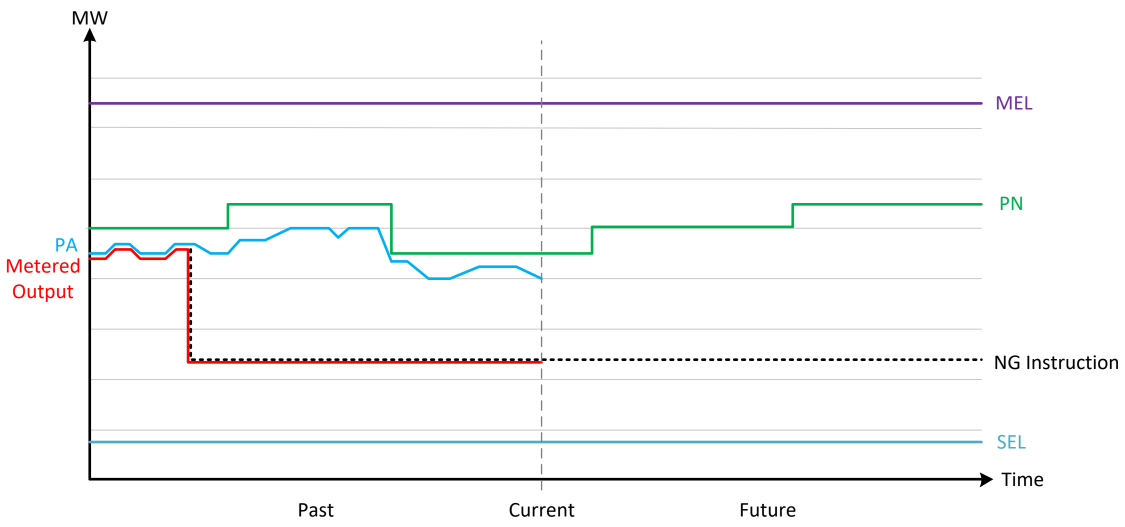


Behaviour During Emergency Instruction

National Grid ESO may ask a Power Park Module to de-synchronise (open breakers) or reduce output without sending a BOA instruction. In this case a telephone instruction will be issued explaining the reason and action required. The ESO will say "This is an emergency instruction".

During this period the PA MW value should behave the same as it would during a BOA period.

Figure 6: PA behaviour during Emergency Instruction



Power Available (PA) – The MW output that would be delivered if the Power Park Module was not instructed to de-load by NG

Behaviour During Shut Down due to High Winds

This section is specifically applicable to wind generators.

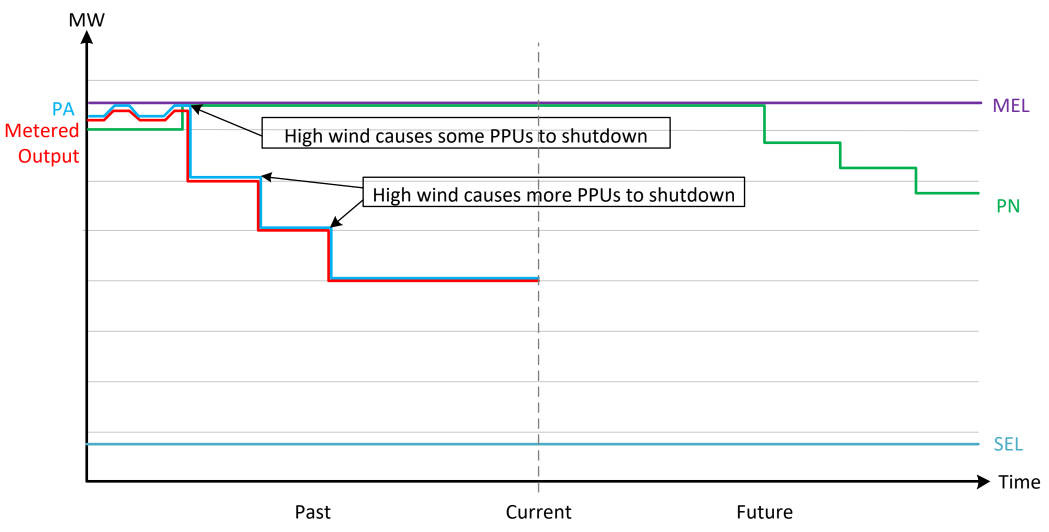
If Power Park Units are shut down due to overspeed / high wind protection, then the PA MW value for the Power Park Module should reduce accordingly. The MW Meter value and the PA MW value should be the same value if the Power Park Module is not deloaded due to a BOA.

If the Power Park Module is deloaded due to a BOA and during this period some or all of the turbines shut down, then the PA MW value should reduce as the turbines shut down.

As soon as the turbines restart the PA MW value should increase accordingly.

It should never be the case during this period of Power Park Unit unavailability that the PA and Meter MW values are different except if the Meter MW is reduced due to BOA instruction or delivering frequency response.

Figure 7: PA Behaviour during High Wind Shutdown



Power Available (PA) will reduce as Power Park Units are shut down – The Metered Output will match the PA value

4

Conclusion

Conclusions

Our zero-carbon operation ambition

Our ambition is to be able to operate a zero-carbon system by 2025. Enabling more intermittent generation to fully participate in providing balancing services is an important step towards this. Initiatives like Power Available, combined with accurate data from the industry to the ESO, will help achieve this.

Operational Impact of Insufficient Data

This document has highlighted the consequence and risks of operating the National Electricity Transmission System with insufficient or incorrect data. To safely, reliably and economically operate the system, the ESO must know what is being generated and what actions are available. When this is not available from intermittent generators, as discussed in this document, the consequences are that those generators cannot be called on to provide services that would benefit the system.

Operational Impact of Accurate Data

Overall, the total cost of balancing the system will be lower than would otherwise be the case as the data becomes more accurate. The Power Available signal is key to this as it enables actual positive and negative reserves to be calculated for the system and therefore the correct actions to be taken by the ESO. This will continue to ensure ESO actions are economic and efficient, helping to minimise balancing costs.

Consistent accurate data will also improve the confidence the control room operators have in intermittent generators and lead to Power Park Modules more readily being called upon to operate in response and other reserve services.

A

Appendix

Definitions

Definitions

The complete Grid Code can be found online at:
https://www.nationalgrideso.com/codes/grid-code

The Grid Code sets out the operating procedures and principles governing the relationship between The Company and all Users of the National Electricity Transmission System, be they Generators, DC Converter owners, Suppliers or Non-Embedded Customers. The Grid Code specifies day-to-day procedures for both planning and operational purposes and covers both normal and exceptional circumstances

The version used in the writing of this document was *The Grid Code Issue 6 Revision 1*. Where newer updates or errors contradict this document, the Grid Code's latest release is the authority.

Grid Code Defined Terms	
Power Available	A signal prepared in accordance with good industry practice, representing the instantaneous sum of the potential **Active Power** available from each individual **Power Park Unit** within the **Power Park Module** calculated using any applicable combination of meteorological (including wind speed), electrical or mechanical data measured at each **Power Park Unit** at a specified time. **Power Available** shall be a value between 0MW and **Registered Capacity** or **Maximum Capacity** which is the sum of the potential **Active Power** available of each **Power Park Unit** within the **Power Park Module.** A turbine that is not generating will be considered as not available. For the avoidance of doubt, the **Power Available** signal would be the **Active Power** output that a **Power Park Module** could reasonably be expected to export at the **Grid Entry Point** or **User System Entry Point** taking all the above criteria into account including **Power Park Unit** constraints such as optimisation modes but would exclude a reduction in the **Active Power** export of the **Power Park Module** instructed by **The Company** (for example) for the purposes selecting a **Power Park Module** to operate in **Frequency Sensitive Mode** or when an **Emergency Instruction** has been issued.
Frequency Sensitive Mode	A **Genset**, or **Type C Power Generating Module** or **Type D Power Generating Module** or **DC Connected Power Park Module** or **HVDC System** operating mode which will result in **Active Power** output changing, in response to a change in **System Frequency**, in a direction which assists in the recovery to **Target Frequency**, by operating so as to provide **Primary Response** and/or **Secondary Response** and/or **High Frequency Response**.
Primary Response	The automatic increase in **Active Power** output of a **Genset** or, as the case may be, the decrease in **Active Power Demand** in response to a **System Frequency** fall. This increase in **Active Power** output or, as the case may be, the decrease in **Active Power Demand** must be in accordance with the provisions of the relevant **Ancillary Services Agreement** which will provide that it will be released increasingly with time over the period 0 to 10 seconds from the time of the start of the **Frequency** fall on the basis set out in the **Ancillary Services Agreement** and fully available by the latter, and sustainable for at least a further 20 seconds. The interpretation of the **Primary Response** to a –0.5 Hz frequency change is shown diagrammatically in Figure CC.A.3.2 and Figure ECC.A.3.2

Secondary Response	The automatic increase in **Active Power** output of a **Genset** or, as the case may be, the decrease in **Active Power Demand** in response to a **System Frequency** fall. This increase in **Active Power** output or, as the case may be, the decrease in **Active Power Demand** must be in accordance with the provisions of the relevant **Ancillary Services Agreement** which will provide that it will be fully available by 30 seconds from the time of the start of the **Frequency** fall and be sustainable for at least a further 30 minutes. The interpretation of the **Secondary Response** to a -0.5 Hz frequency change is shown diagrammatically in Figure CC.A.3.2 or Figure ECC.A.3.2.
High Frequency Response	An automatic reduction in **Active Power** output in response to an increase in **System Frequency** above the **Target Frequency** (or such other level of **Frequency** as may have been agreed in an **Ancillary Services Agreement**). This reduction in **Active Power** output must be in accordance with the provisions of the relevant **Ancillary Services Agreement** which will provide that it will be released increasingly with time over the period 0 to 10 seconds from the time of the **Frequency** increase on the basis set out in the **Ancillary Services Agreement** and fully achieved within 10 seconds of the time of the start of the **Frequency** increase and it must be sustained at no lesser reduction thereafter. The interpretation of the **High Frequency Response** to a + 0.5 Hz frequency change is shown diagrammatically in Figure CC.A.3.3 and Figure ECC.A.3.3
Balancing Code 1 Descriptions	
Maximum Export Limit (defined under BC1.A.1.3.1)	A series of MW figures and associated times, making up a profile of the maximum level at which the **BM Unit** may be exporting (in MW) to the **National Electricity Transmission System** at the **Grid Entry Point** or **Grid Supply Point** or **GSP Group**, as appropriate. For a **Power Park Module,** the Maximum Export Limit should reflect the maximum possible **Active Power** output from each **Power Park Module** consistent with the data submitted within the **Power Park Module Availability Matrix** as defined under BC.1.A.1.8. For the avoidance of doubt, in the case of a **Power Park Module** this would equate to the **Registered Capacity** less the unavailable **Power Park Units** within the **Power Park Module** and not include weather corrected MW output from each **Power Park Unit.**
Stable Export Limit (defined under BC1.A.1.5)	Stable Export Limit (SEL) expressed in MW at the **Grid Entry Point** or **Grid Supply Point** or **GSP Group**, as appropriate, being the minimum value at which the **BM Unit** can, under stable conditions, export to the **National Electricity Transmission System**.
Physical Notification (defined under BC1.A.1.1)	For each **BM Unit**, the **Physical Notification** is a series of MW figures and associated times, making up a profile of intended input or output of **Active Power** at the **Grid Entry Point** or **Grid Supply Point**, as appropriate. For each **Settlement Period**, the first “from time” should at the start of the **Settlement Period** and the last “to time” should be at the end of the **Settlement Period**.
Notice to Deviate from Zero (NDZ) – (defined under BC1.A.1.5)	Notice to Deviate from Zero (NDZ) output or input, being the notification time required for a **BM Unit** to start importing or exporting energy, from a zero **Physical Notification** level as a result of a **Bid-Offer Acceptance**, expressed in minutes.

Minimum Zero Time (MZT) (defined under BC1.A.1.5)	Minimum Zero Time (MZT), being either the minimum time that a **BM Unit** which has been exporting must operate at zero or be importing, before returning to exporting or the minimum time that a **BM Unit** which has been importing must operate at zero or be exporting before returning to importing, as a result of a **Bid-Offer Acceptance**, expressed in minutes.
Minimum Non-Zero Time (MNZT) (defined under BC1.A.1.5)	Minimum Non-Zero Time (MNZT), expressed in minutes, being the minimum time that a **BM Unit** can operate at a non-zero level as a result of a **Bid-Offer Acceptance**
Bid-Offer Acceptance	(a) A communication issued by **The Company** in accordance with BC2.7; or (b) an **Emergency Instruction** to the extent provided for in BC2.9.2.3
MW Meter	Operational Metering as measured at the Grid Entry Point. **BM Participants** must provide operational metering for their total output and for any individual component that may have an output greater than 1MW. This metering must have the following accuracy; a. For a **BM Unit** with either **Generation Capacity** greater than 100MW or **Demand Capacity** greater than 100MW metering accuracy better than 0.5% b. For a **BM Unit** with a **Generation Capacity** greater than 10MW but less than or equal to 100MW or **Demand Capacity** greater than 10MW but less than or equal to 100MW metering accuracy better than 1% c. For all other **BM Units** an accuracy better than 2.5% is required

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