### SURVEY ON ANCILLARY SERVICES PROCUREMENT, BALANCING MARKET DESIGN 2019

ENTSO-E WGAS May 2020

05.05.2020



## **Table of Contents**

#### Introduction (Slides 3 - 4)

#### Ancillary Services (Slides 5 - 107)

- Types of Market Design (Slide 6)
- Frequency Containment Reserve (Slides 7 28)
- Frequency Restoration Reserve (Slides 29 81)
- Replacement Reserve (Slides 82 107)

Imbalance Settlement (Slides 108 - 139) Load participation (Slides 140 – 157) Voltage control (Slides 158 - 201) Black start (Slides 202 - 225)



ENTSO-E Survey on Ancillary services procurement, Balancing market design 2019

The purpose of this survey is to provide an overview of the different market arrangements in place throughout Europe regarding to Ancillary services procurement and Balancing market design.

The maps illustrate how different approaches have been taken to the design elements across Europe.

The Ancillary Services Working Group members who responded to the questionnaire are as follows:

 Austria, Belgium, Bosnia & Herzegovina, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland & NI, Italy, Latvia, Lithuania, Luxemburg, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Netherlands, United Kingdom.



## Introduction (2)

This document is expected to help the introduction of the Network Code Electricity Balancing.

It is meant as a quite comprehensive, but user-friendly set of information on the existing arrangements.

Caveats:

- This is a relatively high-level exercise (not all details are captured).
- Developing a single set of definitions for the purpose of this survey, we experienced the difficulty to match the various concepts used in different countries. As a consequence, in some specific cases, the position of a country in a certain group might be debatable.
- This is based on information updated in April 2020 and describes the mechanisms in place in 2019, irrespective of any updates which might already be foreseen for the future.
- Visualizing the answers we distinguished the TSO who responded the questionnaire, but doesn't have answer to the certain question (marked with "N/A") from the TSO who did not response the questionnaire (marked with "Missing data").





# **Ancillary Services**

(Referring to questions of AS survey from AS1.0 to AS17.8)



#### What is the balancing process in place?



Definition of answer	
Central Dispatch	Central dispatch means a scheduling and dispatching model where the generation schedules and consumption schedules as well as dispatching of power generating facilities and demand facilities, in reference to dispatchable facilities, are determined by a TSO within the integrated scheduling process.
Self-Dispatch - Portfolio Based	Self Dispatch System – Portfolio based means a scheduling and dispatching model where the aggregated generation schedules and consumption schedules as well as dispatching of power generating facilities and demand facilities are determined by the scheduling agents of those facilities.
Self-Dispatch - Unit Based	Self Dispatch System – Unit based means a scheduling and dispatching model where power generating facilities and demand facilities follow their own generation schedules or consumption schedules.



Missing data N/A Central Dispatch Self-Dispatch - Portfolio Based Self-Dispatch - Unit Based



#### Using Frequency Containment Reserve



Definition of question	
Frequency Containment Reserve (FCR)	Operating reserves activated for stabilizing System Frequency after an imbalance.







efinition of question	
rocurement Scheme	Background of the offer, which is closest to the real operation time.
efinition of answer	
ybrid	Combination.
landatory only	Generators connected to the grid are obligated to reserve a certain amount of capacity in order to meet TSO requirements, for a fixed price set by TSO, NRA or for free.
<u>larket only</u>	There is no contract or obligation for a grid user to offer the reserve (before the offer). The grid user can voluntary participate in the market (e.g. tender, auction, market platform (like PX)) and bid a price or customize his offer (e.g. the volume, timeframe). The market result may lead to a bilateral contract.







Definition of question	
Product Resolution (in MW)	The minimum bid size into the balancing market.







Definition of question	
roduct Resolution (in time)	The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).





#### **Frequency Containment Reserve - Capacity - Distance to real time of reserve products auctions**



Definition of question	
Distance to real time of reserve products auctions	The time ahead from real time when auction/agreement for an specific balancing product takes place (for instance = 1 year in the case of a reserve agreement signed 1 year ahead of real time).





**Frequency Containment Reserve - Capacity - Provider** 





Missing data Generators Only Generators + Load Generators + Pump Storage Generators + Load + Pump Storage Generators + Batteries Generators + Load + Batteries Generators + Load + Pump Storage + Batteries





Definition of question	
Symmetrical Product	Upward regulation volume and for downward regulation volume has to be equal.





#### **Frequency Containment Reserve - Capacity - Settlement Rule**



Definition of question	
Settlement Rule	The pricing rules for settlement.
Definition of answer	
Marginal Pricing	All capacity or balancing energy settled at the same price – price of the most expansive capacity bid procured or most expansive balancing energy bid activated.
Pay as bid	Contracted parties who provide a service are paid based on their offer price.
Regulated Price	Price for this service is based on a price that is set by the relevant regulatory authority.







Definition of question	
Cost Recovery Scheme	From who are the costs recovered.
Definition of answer	
Balance Responsible Party (BRP)	Balancing Responsible Party means a market participant or its chosen representative responsible for its Imbalances.
<u>Grid User</u>	The natural or legal person supplying to, or being supplied with active and/or reactive power by a TSO or DSO.
Hybrid	Combination.





#### **Frequency Containment Reserve - Capacity - Monitoring**



<b>Definition of question</b>	
Monitoring	Refers to the type of monitoring in place by the system operator to ensure performance of plant.
Definition of answer	
Ex-post Check	When the monitoring of performance of plant carried out 24 hours after the delivery period.
Hybrid	Combination.

Monitoring of delivery of ancillary services in real time.





#### Frequency Containment Reserve - Capacity - Transfer of BSPs obligation allowed







Frequency Containment Reserve - Capacity - In case transfer obligation is allowed, is there an organised secondary market?



Definition of answer	
Secondary Market for reserve	Trading procedure between the BSPs (where at least one BSP has contract with the TSO) to
obligation	ensure the prescribed reserve amount of the TSO.







Definition of question	
Procurement Scheme	Background of the offer, which is closest to the real operation time.
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#### Frequency Containment Reserve - Energy - Free Bids allowed



Definition of question	
Energy Bids	Acceptable Energy Bids.
Free Offers	Offers without a pre-contract for balancing capacity are allowed.
Pre contracted	Balancing Capacity has been procured from BSP.





**Frequency Containment Reserve - Energy - Product Resolution (in MW)** 



Definition of question	
Product Resolution (in MW)	The minimum bid size into the balancing market.







Definition of question	
Product Resolution (in time)	The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).





**Frequency Containment Reserve - Energy - Provider** 





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#### **Frequency Containment Reserve - Energy - Monitoring**



Definition of question	
Monitoring	Refers to the type of monitoring in place by the system operator to ensure performance of plant.
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<u>Hybrid</u>	Combination.
Real-Time Monitoring	Monitoring of delivery of ancillary services in real time.





#### Frequency Containment Reserve - Energy - Transfer of BSPs obligation allowed







Frequency Containment Reserve - Energy - In case transfer obligation is allowed, is there an organised secondary market?



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#### Using Frequency Restoration Reserve (Automatic)



Definition of question	
Frequency Restoration Reserve (FRR)	Reserves activated to restore System Frequency to the Nominal Frequency and, where applicable, power balance to the scheduled value. aFRR means automatic FRR, mFRR means manual FRR.







Definition of question	
Procurement Scheme	Background of the offer, which is closest to the real operation time.
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#### **Frequency Restoration Reserve (Automatic) - Capacity - Product Resolution (in MW)**



Definition of question	
Product Resolution (in MW)	The minimum bid size into the balancing market.







#### Frequency Restoration Reserve (Automatic) - Capacity - Distance to real time of reserve products auctions



Definition of question	
Distance to real time of reserve products auctions	The time ahead from real time when auction/agreement for an specific balancing product takes place (for instance = 1 year in the case of a reserve agreement signed 1 year ahead of real time).





**Frequency Restoration Reserve (Automatic) - Capacity - Provider** 





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Definition of question	
Energy Bids	Acceptable Energy Bids.
Free Offers	Offers without a pre-contract for balancing capacity are allowed.
Pre contracted	Balancing Capacity has been procured from BSP.







Definition of question	
Activation rule	How the frequency restoration reserves are activated i.e. by a Pro-Rata system or on the basis of a Merit Order (cheapest being activated first).
Definition of answer	
<u>Merit order</u>	A merit order is a way of ranking available sources of energy in ascending order of their short run marginal costs of production, so that those with the lowest marginal costs are the first ones to be brought online to meet demand.
Pro Rata (Parallel Activation)	All bids always activated in parallel – proportionally.







Definition of question	
Product Resolution (in MW)	The minimum bid size into the balancing market.







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**Frequency Restoration Reserve (Automatic) - Energy - Provider** 





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Frequency Restoration Reserve (Automatic) - Energy - In case transfer obligation is allowed, is there an organised secondary market?



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Secondary Market for reserve	Trading procedure between the BSPs (where at least one BSP has contract with the TSO) to
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### Frequency Restoration Reserve (Automatic) - Energy - Activation time of aFRR from 0 to max



Definition of question	
Activation Time	Activation Time means the period of time between receipt of a valid instruction by the Activation Optimisation Function and the end of ramping to meet that instruction.





Frequency Restoration Reserve (Automatic) - Energy - Are activations possible for other purposes than for balancing?



Definition of question	
Activation Purpose	Are activations for other purposes than Balancing (e.g. congestion management) possible?





# Using Frequency Restoration Reserve (Manual)



<u>Definition of question</u>	
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# Frequency Restoration Reserve (Manual) - Capacity - Distance to real time of reserve products auctions



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Definition of answer	
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## Frequency Restoration Reserve (Manual) - Capacity - Transfer of BSPs obligation allowed







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Definition of question	
Energy Bids	Acceptable Energy Bids.
Free Offers	Offers without a pre-contract for balancing capacity are allowed.
Pre contracted	Balancing Capacity has been procured from BSP.







Definition of question	
Activation rule	How the frequency restoration reserves are activated i.e. by a Pro-Rata system or on the basis of a Merit Order (cheapest being activated first).
Definition of answer	
<u>Merit order</u>	A merit order is a way of ranking available sources of energy in ascending order of their short run marginal costs of production, so that those with the lowest marginal costs are the first ones to be brought online to meet demand.
Pro Rata (Parallel Activation)	All bids always activated in parallel – proportionally.







Definition of question	
Product Resolution (in MW)	The minimum bid size into the balancing market.







Definition of question	
Product Resolution (in time)	The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).





### **Frequency Restoration Reserve (Manual) - Energy - Distance to real time of energy products**



Definition of question	
Distance to real time of energy	The time about from real time when TSO activates a given product (for instance 15 minutes
products (reserve products	in the case of mFRR/tertiary energy).
activation)	




Frequency Restoration Reserve (Manual) - Energy - Provider





Missing data Generators Only Generators + Load Generators + Pump Storage Generators + Load + Pump Storage Generators + Batteries Generators + Load + Batteries Generators + Load + Pump Storage + Batteries





Definition of question	
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#### Frequency Restoration Reserve (Manual) - Energy - Transfer of BSPs obligation allowed







Frequency Restoration Reserve (Manual) - Energy - In case transfer obligation is allowed, is there an organised secondary market?



Definition of answer	
Secondary Market for reserve	Trading procedure between the BSPs (where at least one BSP has contract with the TSO) to
obligation	ensure the prescribed reserve amount of the TSO.





#### Frequency Restoration Reserve (Manual) - Energy - Can offered products be partially activated?





Missing data N/A Yes, in all directions No in none direction Only in upward direction Only in downward direction



#### Frequency Restoration Reserve (Manual) - Energy - Activation time of mFRR from 0 to max



Definition of question	
Activation Time	Activation Time means the period of time between receipt of a valid instruction by the Activation Optimisation Function and the end of ramping to meet that instruction.





#### Frequency Restoration Reserve (Manual) - Energy - Are activations possible for other purposes than for balancing?



Definition of question	
Activation Purpose	Are activations for other purposes than Balancing (e.g. congestion management) possible?





# Using Replacement Reserve



Definition of answer	
Replacement Reserve (RR)	Replacement Reserves (RR) means the reserves used to restore/support the required level of FRR to be prepared for further system imbalances. This category includes operating reserves with activation time from Time to Restore Frequency up to hours.





# **Replacement Reserve - Capacity - Procurement Scheme**



Definition of question	
Procurement Scheme	Background of the offer, which is closest to the real operation time.
Definition of answer	
<u>lybrid</u>	Combination.
Mandatory only	Generators connected to the grid are obligated to reserve a certain amount of capacity in order to meet TSO requirements, for a fixed price set by TSO, NRA or for free.
<u>Market only</u>	There is no contract or obligation for a grid user to offer the reserve (before the offer). The grid user can voluntary participate in the market (e.g. tender, auction, market platform (like PX)) and bid a price or customize his offer (e.g. the volume, timeframe). The market result may lead to a bilateral contract.





**Replacement Reserve - Capacity - Product Resolution (in MW)** 



Definition of question	
Product Resolution (in MW)	The minimum bid size into the balancing market.







Definition of question	
Product Resolution (in time)	The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).







Page 86

#### **Replacement Reserve - Capacity - Provider**





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# **Replacement Reserve - Capacity - Settlement Rule**



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Settlement Rule	The pricing rules for settlement.
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# **Replacement Reserve - Capacity - Cost Recovery Scheme**



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Definition of answer	
Balance Responsible Party (BRP)	Balancing Responsible Party means a market participant or its chosen representative responsible for its Imbalances.
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Hybrid	Combination.





#### **Replacement Reserve - Capacity - Monitoring**



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#### **Replacement Reserve - Energy - Provider**





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Regulated Price	Price for this service is based on a price that is set by the relevant regulatory authority.





# **Replacement Reserve - Energy - Cost Recovery Scheme**



Definition of question	
Cost Recovery Scheme	From who are the costs recovered.
Definition of answer	
Balance Responsible Party (BRP)	Balancing Responsible Party means a market participant or its chosen representative responsible for its Imbalances.
<u>Grid User</u>	The natural or legal person supplying to, or being supplied with active and/or reactive power by a TSO or DSO.
Hybrid	Combination.





#### **Replacement Reserve - Energy - Monitoring**



<b>Definition of question</b>	
Monitoring	Refers to the type of monitoring in place by the system operator to ensure performance of plant.
Definition of answer	
Ex-post Check	When the monitoring of performance of plant carried out 24 hours after the delivery period.

Monitoring of delivery of ancillary services in real time.



Combination.



# **Replacement Reserve - Energy - Transfer of BSPs obligation allowed**







Replacement Reserve - Energy - In case transfer obligation is allowed, is there an organised secondary market?



Definition of answer	
Secondary Market for reserve	Trading procedure between the BSPs (where at least one BSP has contract with the TSO) to
obligation	ensure the prescribed reserve amount of the TSO.









Missing data N/A Yes, in all directions No in none direction Only in upward direction Only in downward direction



#### **Replacement Reserve - Energy - Activation time of RR from 0 to max**



Definition of question	
Activation Time	Activation Time means the period of time between receipt of a valid instruction by the Activation Optimisation Function and the end of ramping to meet that instruction.





#### **Replacement Reserve - Energy - Are activations possible for other purposes than for balancing?**





# Imbalance settlement

(Referring to questions of AS survey from IS1.0 to IS15.0)




Definition of question	
Balancing Obligation Enforcement	Nature of balance responsibility enforcement.





Imbalance settlement - Exemptions for RES



Definition of question	
Exemptions	Market participants which do not have obligations to be responsible for its imbalance.





# Imbalance settlement - Exemptions for Generators licensed for the AS market



efinition of question	
Exemptions	Market participants which do not have obligations to be responsible for its imbalance.





Imbalance settlement - Exemptions for Other



Definition of question	
Exemptions	Market participants which do not have obligations to be responsible for its imbalance.







Definition of question	
xemptions	Those parties that do not have a balancing obligation.







Definition of question	
mbalance Position	The declared energy volume of a balance responsible party used for the calculation of its imbalance.
Number of Imbalance Position	Number of Imbalance Positions is a property of local market design. For each Imbalance Position Imbalance Volume is calculated.



N/A 1 position 2 positions – separate positions for generation and consumption



TSO	Answer
ADMIE	<ul> <li>1 position for consumption</li> <li>Several positions for generation (one per generation unit)</li> <li>1 position for imports</li> <li>1 position for exports</li> </ul>
REN	For generation the imbalance is calculated by imbalance area. A market player can have more than one imbalance area.
TERNA	In Italy we calculate an imbalance volume for each production -different for qualified/not qualified unit in the Ancillary Service Market - and consumption unit.
EirGrid	A single imbalance position for each Scheduling Unit under the Balance Responsible Party as allowed for Central Dispatch Systems





finition of question	
balance Settlement Period	The unit of settlement that is applied to the quantities in which the time series is expressed.







Page 117

# Imbalance settlement - Imbalance Settlement Period - If 2 positions - Consumption





# Imbalance settlement - Number of Prices - If 1 position



Definition of question	
Imbalance Price	The price, be it positive, zero or negative, in each imbalance settlement period for an imbalance in each direction.
Number of Prices	Number of prices for Imbalance Position.
Definition of answer	
Dual Pricing	Imbalance Price does not take system state into account. Different prices for aggravating and non-aggravating imbalance.
Single Pricing	Imbalance Price takes system state into account, same price for aggravating and non- aggravating imbalance.



\* Single Pricing, occasionally dual pricing for TenneT Netherlands.





Definition of question	
Imbalance Price	The price, be it positive, zero or negative, in each imbalance settlement period for an imbalance in each direction.
Number of Prices	Number of prices for Imbalance Position.
Definition of answer	
Dual Pricing	Imbalance Price does not take system state into account. Different prices for aggravating and non-aggravating imbalance.
Single Pricing	Imbalance Price takes system state into account, same price for aggravating and non- aggravating imbalance.







Number of prices for Imbalance Position.
Imbalance Price does not take system state into account. Different prices for aggravating and non-aggravating imbalance.
Imbalance Price takes system state into account, same price for aggravating and non- aggravating imbalance.





Imbalance settlement - Main comp. of Imb. Prices - If 1 position - Aggravating imb.



Definition of question	
Aggravating Imbalance	BRP imbalance same direction as Imbalance Price Area imbalance.
Imbalance Price Area	The area for the calculation of an imbalance price.
Main component of Imbalance Prices	The component that determines imbalance charges most of the time.

Definition of answer	
verage Control Energy Price	Average Control Energy Price is calculated by taking the sum of the control energy prices and dividing it by the number of the prices being examined.
Day Ahead Market Price	Price which evolved on the day ahead market.
ntraday Market Price	The price of the market within regular business hours, short-term prices.
Narginal Control Energy Price	The highest price, which can be acceptable.





Imbalance settlement - Main comp. of Imb. Prices - If 1 position - Reducing imb.



Definition of question	
Imbalance Price Area	The area for the calculation of an imbalance price.
Main component of Imbalance Prices	The component that determines imbalance charges most of the time.
Reducing Imbalance	BRP imbalance opposite direction as Imbalance Area imbalance.
Definition of answer	
Average Control Energy Price	Average Control Energy Price is calculated by taking the sum of the control energy prices and dividing it by the number of the prices being examined.
Day Ahead Market Price	Price which evolved on the day ahead market.
Intraday Market Price	The price of the market within regular business hours, short-term prices.
Marginal Control Energy Price	The highest price, which can be acceptable.





Imbalance settlement - Main comp. of Imb. Prices - If 2 positions - For generation "aggravating imb."



Definition of question	
Aggravating Imbalance	BRP imbalance same direction as Imbalance Price Area imbalance.
Imbalance Price Area	The area for the calculation of an imbalance price.
Main component of Imbalance Prices	The component that determines imbalance charges most of the time.
Definition of answer	

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larginal Control Energy Price	The highest price, which can be acceptable.





Imbalance settlement - Main comp. of Imb. Prices - If 2 positions - For consumption "aggravating imb."



Definition of question	
Aggravating Imbalance	BRP imbalance same direction as Imbalance Price Area imbalance.
Imbalance Price Area	The area for the calculation of an imbalance price.
Main component of Imbalance Prices	The component that determines imbalance charges most of the time.
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Imbalance settlement - Main comp. of Imb. Prices - If 2 positions - For generation "reducing imb."



Definition of question	
Imbalance Price Area	The area for the calculation of an imbalance price.
Main component of Imbalance Prices	The component that determines imbalance charges most of the time.
Reducing Imbalance	BRP imbalance opposite direction as Imbalance Area imbalance.
Definition of answer	
Average Control Energy Price	Average Control Energy Price is calculated by taking the sum of the control energy prices and dividing it by the number of the prices being examined.
Day Ahead Market Price	Price which evolved on the day ahead market.
Intraday Market Price	The price of the market within regular business hours, short-term prices.
Marginal Control Energy Price	The highest price, which can be acceptable.





Imbalance settlement - Main comp. of Imb. Prices - If 2 positions - For consumption "reducing imb."



Definition of question	
Imbalance Price Area	The area for the calculation of an imbalance price.
Main component of Imbalance Prices	The component that determines imbalance charges most of the time.
Reducing Imbalance	BRP imbalance opposite direction as Imbalance Area imbalance.
Definition of answer	
Average Control Energy Price	Average Control Energy Price is calculated by taking the sum of the control energy prices and dividing it by the number of the prices being examined.
Day Ahead Market Price	Price which evolved on the day ahead market.
Intraday Market Price	The price of the market within regular business hours, short-term prices.
Marginal Control Energy Price	The highest price, which can be acceptable.







Definition of question	
Additional Components	Other components which determine imbalance charges.
Main component of Imbalance Prices	The component that determines imbalance charges most of the time.







Definition of question	
Minimal Incentives	Minimal incentives means that there is some method which leads the BRPs to balance their schedules.





Imbalance settlement - Control energy prices used - FCR







Imbalance settlement - Control energy prices used - aFRR







Imbalance settlement - Control energy prices used - mFRR



Key:



Imbalance settlement - Control energy prices used - RR







Imbalance settlement - Start/Stop costs in Imbalance Charges







#### **Imbalance settlement - Publication**



Definition of question	
Final Imbalance Price	Imbalance price means the price, be it positive, zero or negative, in each imbalance settlement period for an imbalance in each direction. Final imbalance price is calculated price for settlement period that cannot be changed anymore.
Publication	Publication of final Imbalance Price.





**Imbalance settlement - Complaint Period** 



Definition of answer	
Complaint Period	Length of time for which complaints can be made which will be considered in relation to settlement (after the finalized data are produced).





#### Imbalance settlement - Gate Closure time for notification of Internal Trade Schedules



Definition of answer	
Gate Closure Times (GCT)	Deadline for the participation to a given market or mechanism.



Missing data N/A 15 min before delivery 30 min before delivery 45 min before delivery 1 hour before delivery x > 1 hour before delivery Ex-post notification allowed



Imbalance settlement - Internal Intra Day Market time period







# Imbalance settlement - Can market participants change the approved schedules after Delivery?



Definition of answer	
Gate Closure Times (GCT)	Deadline for the participation to a given market or mechanism.



Missing data N/A Always (GCT after delivery) Never (GCT before delivery) Only in case of IT or any other problems (TSO approval)





# Load participation

(Referring to questions of AS survey from L1.0 to L7.0)



Load participation - Load providers use the same market mech. and act. proc. as generation (cap.&energy)







Load participation - Specific market solution use for load providers of balancing services (cap.&energy)





Missing data N/A Long term contracts TSO-BSP Long term auctions Short term auctions Specific market solution





efinition of question	
oduct Resolution (in MW)	The minimum bid size into the balancing market.







Definition of question	
Product Resolution (in time)	The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).




## Load participation - What type of specific activation rule do you follow with load type BSP's?



Definition of question	
Activation rule	How the frequency restoration reserves are activated i.e. by a Pro-Rata system or on the basis of a Merit Order (cheapest being activated first).
Definition of answer	
Merit order	A merit order is a way of ranking available sources of energy in ascending order of their short run marginal costs of production, so that those with the lowest marginal costs are the first ones to be brought online to meet demand.
Pro Rata (Parallel Activation)	All bids always activated in parallel – proportionally.





# Load participation - Settlement Rule



Definition of question		
Settlement Rule	The pricing rules for settlement.	
Definition of answer		
<u>Hybrid</u>	Combination.	
Marginal Pricing	All capacity or balancing energy settled at the same price – price of the most expansive capacity bid procured or most expansive balancing energy bid activated.	
Pay as bid	Contracted parties who provide a service are paid based on their offer price.	
Regulated Price	Price for this service is based on a price that is set by the relevant regulatory authority.	





Load participation - Participating in the balancing services - Aggregators







# Load participation - Participating in the balancing services - Large consumers







# Load participation - Participating in the balancing services - Pump storage units







# Load participation - Participating in the balancing services - Aggregated small size consumers







# Load participation - Participating in the balancing services - Small consumers







Load participation - Participating in the balancing services - Other storage







Load participation - Participating in the balancing services - Other







Load participation - What is the product resolution for load BSP's to participate at these balancing services?







#### Load participation - Monitoring



<b>Definition of question</b>	
Monitoring	Refers to the type of monitoring in place by the system operator to ensure performance of plant.
Definition of answer	
Ex-post Check	When the monitoring of performance of plant carried out 24 hours after the delivery period.
<u>Hybrid</u>	Combination.

Monitoring of delivery of ancillary services in real time.







Load participation - What level of control of the load does the TSO have?









# Voltage control

# (Referring to questions of AS survey from VC1.0 to VCQ12.0)



Voltage control - Voltage support as part of ancillary services







TSO	Answer
APG	The capability to provide reactive power is mandatory (activation based on contract) In emergency state (according to SOGL) voltage control/Q(U) is mandatory for Type B/C/D.
AST	All power plants connected to the transmission grid are obliged to provide Voltage Control service.
ČEPS	All units connected to the transmission grid (220kV +) must be capable of voltage control.
EirGrid	Mandatory Grid Code requirement for transmission connected units. Commercial opportunities for all other providers (or provisions over and above mandatory requirement).
Elering	It is mandatory. All power plants that are connected to the main grid must have voltage control capability.
Elia	The provision of the voltage control service is not mandatory but is based on a voluntary participation of production units via a tendering procedure.
EMS	Hydro and thermal power plants. It is mandatory.
Fingrid	Mandatory service for all power plants.
German TSOs	The framework of voltage control requirements for plants connected to the high-voltage grid is provided by the German Transmission Code. Concrete requirements within the given framework are agreed between connecting TSO and power plant operator and included in the grid connection contracts. A similar framework does also exist for medium-voltage grids.



TSO	Answer
HOPS	All power plants need to provide voltage control in mandatory range by grid code.
LITGRID	All power plant connected to transmission gird. All running generator shall provide voltage support according technical possibilities from generator.
MAVIR ZRt.	If the gross installed capacity is more than 50 MW and the power plant is connected to the transmission grid, or 132 kV, the service is mandatory.
National Grid	Mandatory Service (Grid Code Provision) for Conventional Generators and Windfarms connected to the transmission system. Commercial Service for Conventional Generators and Windfarms connected to the transmission system for provision over and above Mandatory levels.
NOSBiH	Yes.
PSE S.A.	All generating units according to Grid Code are obliged to control the voltage, centrally dispatched units are contracted for such service.
Red Eléctrica de Espana	Mandatory for units >= 30 MW of rated power and connected to transmission grid.
REN	All conventional generators and solar power plants have to provide.
RTE	No.



TSO	Answer
SEPS	Primary voltage control is mandatory and secondary voltage control is paid service. We use secondary voltage control just at transmission level (400 kV and 220 kV).
Statnett SF	Generators >= 1MVA. Yes, it is a mandatory service.
Swissgrid	All power plants directly connected to the transmission system which are in operation (production, pump mode or synchronous/phase shifting mode), within the scope of their available reactive power that can be exchanged with the transmission system without compromising the active power.
TenneT Netherlands	Not mandatory.
TERNA	It's mandatory for the power units which have nominal power greater or equal than 10 MVA and for all the new HV connected PPM and synchronous generators (formerly PPM had only obligation on power factor cosine phi).



Voltage control - Determination the optimal use of reactive energy







Voltage control - In case of opt.problem - objective function







## Voltage control - Type of optimization approach



Definition of question	
Optimization approach	What kind of Voltage Control optimization is available in your control area?





# Voltage control - Implicit / explicit offers bids from BSP



Definition of question	
Explicit offer	Specified and limited bids - for Standing unit





**Voltage control - Provider - Generators** 













Voltage control - Provider - Industrial consumers







Voltage control - Provider - Windfarm producers







Voltage control - Provider - Photovoltaic systems







Voltage control - Provider - HVDC links







## Voltage control - Provider - Windfarm producers or photovoltaic systems connected on the DSO













Voltage control - Provider - None







# Voltage control - Type of regulations for the voltage control demanded to the power plants - No regulation







# Voltage control - Type of regulations for the voltage control demanded to the power plants - Reactive setpoint







# Voltage control - Type of regulations for the voltage control demanded to the power plants - Voltage stator setpoint















VCQ3.4

Voltage control - Type of regulations for the voltage control demanded to the power plants - Voltage setpoint at the connexion point function of a signal sent by the TSO (possibility of variation of the EHV setpoint)






Voltage control - Type of regulations for the voltage control demanded to the power plants - OLTC on the main transformer (manual control)







Voltage control - Type of regulations for the voltage control demanded to the power plants - OLTC on the main transformer (automatic control of the EHV voltage)







Voltage control - If a power plant is able to provide voltage control, which grid it should be connected to?







# Voltage control - Is it a service paid by the TSO?







# Voltage control - Settlement Rule



Definition of question	
Settlement Rule	The pricing rules for settlement.
Definition of answer	
Hybrid	Combination.
Marginal Pricing	All capacity or balancing energy settled at the same price – price of the most expansive capacity bid procured or most expansive balancing energy bid activated.
Pay as bid	Contracted parties who provide a service are paid based on their offer price.
Regulated Price	Price for this service is based on a price that is set by the relevant regulatory authority.









Definition of question	
Monitoring	Refers to the type of monitoring in place by the system operator to ensure performance of plant.
Definition of answer	
Ex-post Check	When the monitoring of performance of plant carried out 24 hours after the delivery period.
<u>Hybrid</u>	Combination.
Real-Time Monitoring	Monitoring of delivery of ancillary services in real time.





# Voltage control - Does the TSO own reactive power compensation systems?







# Voltage control - Owning by the TSO the reactive power compensation systems - Inductance







# Voltage control - Owning by the TSO the reactive power compensation systems - Capacitor banks







# Voltage control - Owning by the TSO the reactive power compensation systems - SVC







# Voltage control - Owning by the TSO the reactive power compensation systems - Synchronous compensator







# Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - Respect a Reactive/Active power ratio







VCQ9.1

Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - Respect of an Active/Reactive Power Diagram at the connexion point







# Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - Min/max fixed value of reactive power







VCQ9.3

Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - Depending of the period of the day and/or year















VCQ9.5

# Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - According to the measurement







VCQ9.6

# Voltage control - Settlement rules for the exchange of reactive power between transmission and distribution grids - No rules







Voltage control - What are the settlement rules for the price of reactive power between transmission and distribution grids?



Definition of question	
Settlement Rule	The pricing rules for settlement.
Definition of answer	
Charges and/or fees	Charges and/or fees if the DSO does not respect the tan Phi and/or the diagram rule.
Regulated Price	Price for this service is based on a price that is set by the relevant regulatory authority.





VCQ10.0

#### Voltage control - Existing of secondary voltage control (SecVolCon) voltage control for the nominated mains?



Definition of answer	
SecVolCon reactive	SecVolCon sending a reactive setpoint to the units (manually or automatically)
SecVolCon voltage	SecVolCon sending a voltage setpoint to the units (manually or automatically)





# Voltage control - Existing of tertiary voltage control









# **Black start**

# (Referring to questions of AS survey from BSQ1.0 to BSQ13.0)



Black Start - Which power plants have to provide black start (for example: capacity, technology etc)? Is it a mandatory service in your country? 1/3

TSO	Answer
ADMIE	Predefined power plants have to provide Black Start service.
APG	Hydro storage power plants. Not mandatory for power plants.
AST	No special rules - agreement with hydro power plant for providing the service.
CREOS Luxembourg	No possibility to provide Black Start from LU
ČEPS	No obligations to provide black start for any unit.
EirGrid	It is not mandatory. Technologies currently providing black start: Hydro, Pumped Storage, Interconnector, Open Cycle Gas Turbines.
Elering AS	Black start service is provided by power plants which are included in the restoration plan as black start service providers. It is not a mandatory service.
ELES	Yes.
Elia	The black-start service is not mandatory and is based on a voluntary participation via a tendering process.
EMS	Some HPP.
Fingrid	Not mandatory, agreed bilaterally with suitable plants.
German TSOs	Black start provision according to respective black-start concepts, based on grid connection and specific contracts.



Black Start - Which power plants have to provide black start (for example: capacity, technology etc)? Is it a mandatory service in your country? 2/3

TSO	Answer
HOPS	All the units who are able to provide BS must provide it.
LITGRID	Power plants that are included in the black start plan must provide the black start service (due to technology).
MAVIR ZRt.	If the gross installed capacity is more than 500 MW and the power plant is connected to the transmission grid, the service is mandatory. But there are some power plants who are able to provide BS capability, but their gross installed capacities are less than 500 MW.
National Grid	Not a mandatory service for generators. However, mandatory for NG to maintain black start capability - Grid Code and Transmission Licence requirements. Black Start services are procured via contracts with power stations.
NOSBiH	Yes.
PSE S.A.	It is not a mandatory service in Poland.
Red Eléctrica de Espana	Mainly hydro units.
REN	BS is not a mandatory service in Portugal. We have a CCGT and a Hydro that provide that service.
RTE	BS not mandatory. Nuclear power plants provide VSC w/o BS.
SEPS	No, this service is not mandatory.



Black Start - Which power plants have to provide black start (for example: capacity, technology etc)? Is it a mandatory service in your country? 3/3

TSO	Answer
SONI	Conventional (Thermal) Power Stations must have black start capability.
Statnett SF	Power plants that have a significance impact on the reconstruction of the network or other critical functions.
Svenska kraftnät	We have contracts with some suppliers of blackstart capability.
Swissgrid	A buildup-cell is defined as a small subnet, limited in area and electrical network, which consists of one power station equipped with black start facilities and one or more power station swith islanding functionality being able to keep frequency, voltage and power stable in this buildup-cell, with an adequate load at its disposal. The buildup-cell needs: -to have a direct connection to the 220kV-level -to be connected to the same or neighboring nodes -lts rotating mass (power output) to be between 200 and 250 MW and a switchable load of 10%.
TenneT Netherlands	Black start is contracted and not a mandatory service.
TERNA	It is mandatory for the power plants defined in the restoration plan.
Transelectrica	Power plants that are included in the Black Start Plan must provide the Black Start Service - due to technology.



Black Start - If a power plant is able to provide black start service, which grid it should be connected to?







# Black Start - Is it a service paid by the TSO?







#### Black Start - Settlement Rule



Definition of question	
Settlement Rule	The pricing rules for settlement.
Definition of answer	
<u>Hybrid</u>	Combination.
Marginal Pricing	All capacity or balancing energy settled at the same price – price of the most expansive capacity bid procured or most expansive balancing energy bid activated.
Pay as bid	Contracted parties who provide a service are paid based on their offer price.
Regulated Price	Price for this service is based on a price that is set by the relevant regulatory authority.





Black Start - Does the TSO own unit for Black start service?







TSO	Answer
ADMIE	No.
APG	Black start units geographically separated.
AST	No.
CREOS Luxembourg	No.
ČEPS	N/A
EirGrid	The TSO considers regional requirements when awarding BS contracts.
Elering AS	No.
ELES	Prescribed amount of BS is area-dependent.
Elia	Elia procured the Black Start service according to the rules described in its Restoration Plan. Typically Elia procured 1 BS unit for the restoration of each regional zone and 1 for the restoration of the 380 kV backbone.
EMS	No.



TSO	Answer
Fingrid	No.
German TSOs	According to respective black-start concept.
HOPS	No.
LITGRID	No special rules for distribution, black start service unit shall be located in such a place, where is feasible to restart main generation units.
MAVIR ZRt.	No special rules.
National Grid	Restoration strategy is to split GB into 6 geographical zones and contract for at least 3 black start providers from each zone.
NOSBiH	No.
PSE S.A.	TSO is obliged to fulfil standards from OH Policy 5.
Red Eléctrica de Espana	It is warranted a good geographical distribution of BS resources.



TSO	Answer
REN	No special rules.
RTE	N/A
SEPS	Yes, we have a set of different rules. Each application for BS providing is assessed separately.
SONI	N/A
Statnett SF	Power plants that have a significance impact on the reconstruction of the network or other critical functions.
Svenska kraftnät	Yes, we have a set of different criterias.
Swissgrid	Distribution of CH in 4 network restoration regions (West, South, Cetraland East): Each region must have 1 buildup-cell.
TenneT Netherlands	Black Start units are contracted in different parts of the network.
TERNA	We have a fixed number of "restoration path,.
Transelectrica	Geographical distance according to respective Black-Start concept.



Black Start - Does the TSO have a regulated amount of BS control (regarding the whole control area)?







# Black Start - Testing the BS ability by the TSO - During the accreditation process only







Black Start - Testing the BS ability by the TSO - After the accreditation process/ Only the operational function of the BS unit (unit is working, not connected to the grid)/Once a year







BSQ8.2

Black Start - Testing the BS ability by the TSO - After the accreditation process/ Only the operational function of the BS unit (unit is working, not connected to the grid)/Several times a year







BSQ8.3
Black Start - Testing the BS ability by the TSO - After the accreditation process/ Only the operational function of the BS unit (unit is working, not connected to the grid)/Occasionally







Black Start - Testing the BS ability by the TSO - After the accreditation process/ Control function of the BS unit (unit is working, connected to the grid and has to provide some predefined orders)/Once a year







Black Start - Testing the BS ability by the TSO - After the accreditation process/ Control function of the BS unit (unit is working, connected to

the grid and has to provide some predefined orders)/Several times a year







Black Start - Testing the BS ability by the TSO - After the accreditation process/ Control function of the BS unit (unit is working, connected to the grid and has to provide some predefined orders)/Occasionally







## Black Start - How often does the TSO practise the method of the BS process (for example using a training simulator)?





Missing data N/A Regularly/once a year Regularly/several times a year Occasionally Regularly



## Black Start - Should be the Black start service provided by a single unit or it is allowed to be a part of a power plant?





Missing data N/A Yes, it can be part of the power plant No, it has to be a single unit



Black Start - How long is the acceptable non-availability period of the BS unit (planned, for example: resurrection & maintenance of the unit)?





Missing data N/A It is not allowed Less than one day Between 1 and 3 days Between 4 and 7 days Depending on the availability of other BS units More than one week









## Black Start - Monitoring of the black start service?



<b>Definition of question</b>	
Monitoring	Refers to the type of monitoring in place by the system operator to ensure performance of plant.
Definition of answer	
Ex-post Check	When the monitoring of performance of plant carried out 24 hours after the delivery period.
Hybrid	Combination.
Real-Time Monitoring	Monitoring of delivery of ancillary services in real time.



