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**Ancillary Services**  
*Unbundling Electricity Products –  
an Emerging Market*  
.....

**Thermal Working Group**  
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The **Union of the Electricity Industry–EURELECTRIC** is the sector association representing the common interests of the electricity industry at pan-European level, plus its affiliates and associates on several other continents.

In line with its mission, EURELECTRIC seeks to contribute to the competitiveness of the electricity industry, to provide effective representation for the industry in public affairs, and to promote the role of electricity both in the advancement of society and in helping provide solutions to the challenges of sustainable development.

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## **Ancillary Services**

### *Unbundling Electricity Products – an Emerging Market*

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## **Thermal Working Group**

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Paper prepared by Thermal Working Group in collaboration with Hydro Working Group

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## EXECUTIVE SUMMARY

Ancillary services are not new. They were and are always needed and used when electricity was and is to be transferred in satisfactory quality (mainly frequency and voltage). What has arrived with the liberalisation of the electricity market is providing and procuring ancillary services – a new market not within but adjacent to the electricity energy market: the market for ancillary services. Depending on the rules of electricity energy markets, the market for ancillary services can interact with the main electricity energy market in a significant manner. This new ancillary services market is bringing new challenges to be faced by generators and raising several new questions.

EURELECTRIC deems it necessary to find comprehensive and exhaustive answers to these questions, in order to adequately pave the road towards a fully functional and sustainable ancillary services market; however, has not tried to do so in the frame of this report.

Nevertheless, members of EURELECTRIC have agreed some principles:

### MESSAGES

- *It is essential to adequately develop an ancillary services market, as far as possible, in parallel with the opening of the electricity market.*
- *Ancillary services and linked deliveries must be properly defined at a European level.*
- *If certain obligations are to be imposed on generators, they must put even burden on all generators, and be adequately compensated.*
- *EURELECTRIC deems it necessary and timely to raise questions regarding the development of the market for ancillary services, and ready to participate in such discussions.*

This report aims to give a short overview of the situation in European countries, to highlight some problems that could hinder the development of the ancillary services market at the present, and to formulate EURELECTRIC's view on how this market ought to work.

Detailed description of the current situation in different countries, together with the questionnaire used to conduct the survey among EURELECTRIC members, can be found in the Annexes.

## I. INTRODUCTION

Historically, the electric utilities were vertically integrated, owning and operating the whole chain of electricity from generation through transmission to distribution and supply. Ancillary services were demanded and provided within the company; it was relatively simple to obtain them, as they were provided by the company's own assets. With liberalisation, that arrangement has changed. The activities of the utility – generation, transmission, distribution, supply – have been separated, with special emphasis on unbundling the monopolistic (transmission, distribution) and competitive (generation, supply) segments. The different parts have in most cases become or are becoming independent legal entities with independent ownership.

When the different market players (e.g. generators) have to work in a competitive manner, it is no longer desirable to oblige them to provide certain services without adequate payment; particularly, when providing the service conflicts with producing electricity to be sold on the market. However, it is not easy to define what ancillary services actually are, and how they should be procured; anyone attempting to create rules for an ancillary services market might soon see his structure rapidly becoming unmanageably complex. On one hand, many different ancillary services could be defined. On the other hand, the energy and ancillary services markets are highly interdependent. In a theoretically ideal situation all ancillary services should be traded separately, where technically feasible, on their own individual free markets. In a realistically workable situation, not more than three or four ancillary services, or 'ancillary service packages' could be subject to market conditions.

In order to provide an overview of how ancillary services are provided and procured in different European countries, this report seeks answers to the following questions:

- how ancillary services markets currently work;
- how ancillary services markets should work.

### I.1 Definition of ancillary services

In its earlier reports, EURELECTRIC (and previously UNIPEDE) gave the following definitions for *ancillary services*:

“... any service to readjust the control parameters of a network”

*Dynamic service rendered by hydraulic power stations, UNIPEDE December 1993*

“... those services provided by generation, transmission and control equipment which are necessary to support the transmission of electric power from producer to purchaser”

*Connection Rules for Generation and Management of Ancillary Services, EURELECTRIC May 2000*

In the Directive completing the internal electricity market, ancillary services are defined as:

“... all services necessary for the operation of transmission and/or distribution networks”

*Directive [...] concerning common rules for the internal market in electricity, 2003/54/EC*

As already pointed out in EURELECTRIC's May 2000 report, from a technical point of view it is useful to distinguish between *ancillary services* and *system services*. **System services** are all services provided by some system function (such as a system operator or a grid/network operator) to users connected to the system. **Ancillary services** are services procured by a system functionality (system operator or grid/network operator) from system users in order to be able to provide system services. A further distinction can be made between system services enabling system integrity and *transmission services* which enable and assist economic power transfer.

In several markets in Europe, depending on their structure, a new type of ancillary services is developing importance as the penetration of renewable energy sources, particularly that of wind, is increasing in the electricity market. The electricity produced by these generators usually enjoys guaranteed transmission and distribution, while at the same time their reliability is low and the delivery of electricity is unpredictable<sup>1</sup>. Hence, the system operator needs other sources, which are quickly available if needed, to ensure back-up to these sources. Although the service of ensuring this back-up is basically similar to the reserves described in this report, its increasing volume and the special circumstances that make it necessary leads EURELECTRIC to believe that this service should be dealt with separately from other ancillary services. The costs of the **back-up service** should be recovered from generators whose production has low predictability (what one might call the “causer pays” principle).

This report focuses on ancillary services.

Taking the above into consideration, EURELECTRIC in this report uses the following definition for ancillary services:

## DEFINITION

*Ancillary services are all services required by the transmission or distribution system operator to enable them to maintain the integrity and stability of the transmission or distribution system as well as the power quality.*

Ancillary services are procured by the system operators and are provided by network users (generators, customers) or system assets.

<sup>1</sup> An example of power output from wind turbines

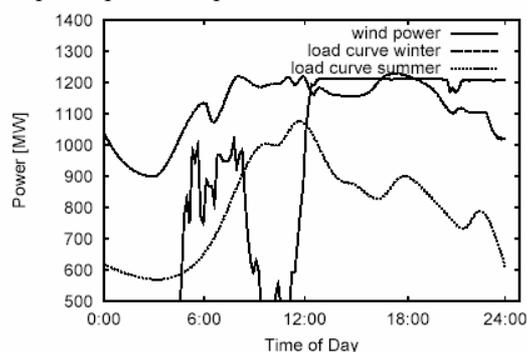


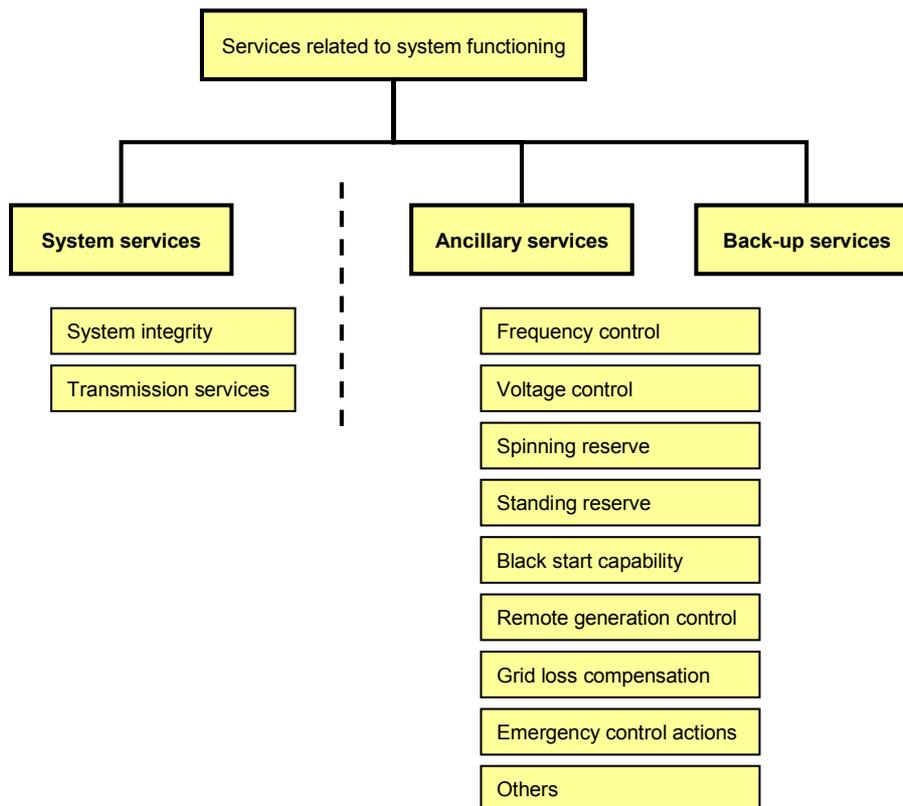
Figure 1: Typical curve of load of a north Germany utility (summer and winter). One can see the fluctuations of the power output of a wind turbine as well, scaled up to the installed power of all turbines in the supply region of the utility. Balancing effects smoothing this curve, have not been considered here.

### Forecast of Regional Power Output of Wind Turbines

Hans Georg Beyer, Detlev Heinemann, Harald Mellinghoff, Kai Monnich, Hans-Peter Waldl  
Carl von Ossietzky University of Oldenburg

Acknowledging that several further ancillary services can be and currently are defined in different countries, this report discusses the following ancillary services (for definitions, consult the next chapter):

1. frequency control
2. voltage control
3. spinning reserve
4. standing reserve
5. black start capability
6. remote automatic generation control
7. grid loss compensation
8. emergency control action.



## I.2 Description of individual ancillary services

**Frequency control (FC):** Maintaining the frequency within the given margins by continuous modulation of active power.

*Primary Response:* The automatic response to frequency changes released increasingly with time over a period of some seconds from the time of frequency.

*Secondary Response:* The automatic response to frequency changes which takes over from the Primary Response and partially recovers system frequency.

In certain cases, high frequency response can be separately defined:

*High Frequency Response:* An automatic reduction in active power output in response to an increase in system frequency, released increasingly with time over the period 0 to some seconds from the time of the frequency increase.

**Voltage control (VC):** Maintaining voltage through injecting or absorbing reactive power by means of synchronous or static compensation.

**Spinning reserve (SP):** Increase or decrease in generation or reduction in consumption that can be provided at short notice, carried out by partially loaded generating units and interruptible customers.

**Standing reserve (ST):** Increase in generation or reduction in consumption that can be provided by those generating units that are not synchronously on-line, or by interruptible customers.

**Black start capability (BS):** The capability of a generating unit to start up without an external power supply, called on as a means of restoring supplies following a major failure on all or part of the network.

**Remote automatic generation control (RG):** A means of regulating frequency by controlling the output through a centrally-based control system. It can mean operating the Secondary Response but also controlling a whole plant.

**Grid loss compensation (GL):** Compensating the transmission system losses between the generators and the loads.

**Emergency control actions (EC):** Maintenance and use of special equipment (e.g. power-system stabilisers and dynamic-braking resistors) to maintain a secure transmission system.

### **I.3 Other definitions used in the report**

**TSO:** Transmission System Operator

**DSO:** Distribution System Operator

**ISO:** Independent System Operator

**System operator:** TSO or DSO or ISO

Distinction between the economic terms used in the report:

<b>Cost of ancillary service</b>	the actual financial burden occurring at the ancillary service provider when producing and providing a certain ancillary service
<b>Price of ancillary service</b>	paid by the procurer of the ancillary service (system operator) to the ancillary service provider
<b>End-user price of ancillary service</b>	built in the tariff of electricity, paid by the final buyer and user of electricity (assuming that final buyers and users of electricity pay the full cost of the ancillary services, which is not always true)

## II. Ancillary Services in Europe

In order to collect structured information on the actual systems functioning in different countries, members of WG Thermal and WG Hydro were asked to complete a questionnaire (see Annex I). For the complete answers, see Annex II.

Answers are given from the following countries:



Austria	AT
Belgium	BE
Cyprus	CY
Czech Republic	CZ
Denmark	DK
Finland	FI
France	FR
Germany	DE
Hungary	HU
Iceland	IE
Ireland	IR
Netherlands	NL
Norway	NO
Poland	PL
Portugal	PT
Spain	ES
Sweden	SE
Slovakia	SK
United Kingdom	UK

Cyprus has not yet gained enough experience to answer the questionnaire in detail. There are significant differences in ancillary service markets in the different regions of Germany.

The questionnaire comprised 8 types of ancillary services:

- frequency control (FC);
- voltage control (VC);
- spinning reserve (SP);
- standing reserve (ST);
- black start capacity (BS);
- remote automatic generation control (RG);
- grid loss compensation (GL);
- emergency control actions (EC).

## II.1 Who provides and procures ancillary services?

### II.1.1 What are considered ancillary services?

The frequency control, voltage control, spinning and standing reserve and black start capacity are considered ancillary services in almost every country (VC not in Spain, SP not in the UK, ST not in Austria, BS not in Norway and Spain). The remote automatic generation control is ancillary service in circa 60% of the countries. The grid loss compensation and emergency control actions are not ancillary services, only in Austria, Iceland, Germany and Austria, the Netherlands, Iceland, Germany respectively.

	AT	BE	CZ	DK	FI	FR	DE	HU	IE	IR	NL	NO	PL	PT	ES	SE	SK	UK
<b>FC</b>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>VC</b>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>SP</b>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>ST</b>			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>BS</b>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>RG</b>	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>GL</b>	✓		✓			✓	✓		✓									
<b>EC</b>	✓		✓			✓	✓		✓		✓						✓	
<i>FC Frequency control</i>						<i>VC Voltage control</i>						<i>SP Spinning reserve</i>						
<i>ST Standing reserve</i>						<i>BS Black start capacity</i>						<i>RG Remote automatic generation control</i>						
<i>GL Grid loss compensation</i>						<i>EC Emergency control actions</i>												

The shaded fields in the tables below indicate services which are not considered ancillary service in the particular country.

### II.1.2 Is it mandatory? On whom?

The frequency control is mandatory in all countries except Finland, on TSO and generators, in some countries only above a certain capacity (5 to 50 MW). The voltage control is not mandatory only in the Netherlands and partly in Finland. The spinning and standing reserve are mandatory in most countries. The black start capacity is mandatory in half of the countries. The three further ancillary services are mandatory in the minority of the countries. In the Czech Republic, none of the ancillary services is mandatory.

	AT	BE	CZ	DK	FI	FR	DE	HU	IE	IR	NL	NO	PL	PT	ES	SE	SK	UK
<b>FC</b>	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>VC</b>	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
<b>SP</b>	✓	✓		✓			✓	✓	✓	✓						✓	✓	
<b>ST</b>				✓			✓	✓	✓	✓				✓		✓	✓	
<b>BS</b>	✓	✓		✓			✓	✓	✓							✓	✓	
<b>RG</b>	✓	✓					✓	✓	✓				✓	✓				✓
<b>GL</b>	✓	✓					✓		✓	✓								
<b>EC</b>	✓	✓				✓	✓	✓	✓	✓			✓					
<i>FC Frequency control</i>						<i>VC Voltage control</i>						<i>SP Spinning reserve</i>						
<i>ST Standing reserve</i>						<i>BS Black start capacity</i>						<i>RG Remote automatic generation control</i>						
<i>GL Grid loss compensation</i>						<i>EC Emergency control actions</i>												

T=TSO; P=PSO; G=Generators; N=Network devices; L=Load; D=Distributors; I=ISO

### II.1.3 Who procures these ancillary services?

TSOs procure ancillary services in all countries.

	AT	BE	CZ	DK	FI	FR	DE	HU	IE	IR	NL	NO	PL	PT	ES	SE	SK	UK	
<b>FC</b>	T	T	T	T	T	T	GT	P	T		T	T	T	T	I	T	T	T	
<b>VC</b>	T	T	T	T	T	T		P	T	T	TD	T	T	T	I	T	T	T	T
<b>SP</b>	T	T	T	T	T	T		P	T	T	T	T			I	T	T	T	
<b>ST</b>			T	T	T	T		P	T	T	T	T	T	T		T	T	T	T
<b>BS</b>	T	T	T	T		T		P	T	T	T		T			T	T	T	T
<b>RG</b>	T	T	T		G	T		P	T		G			T	I			T	
<b>GL</b>	T		T		T	T		P	T		TD								
<b>EC</b>	T	T	T			T		P	T		T								
<i>FC Frequency control</i>								<i>VC Voltage control</i>							<i>SP Spinning reserve</i>				
<i>ST Standing reserve</i>							<i>BS Black start capacity</i>							<i>RG Remote automatic generation control</i>					
<i>GL Grid loss compensation</i>							<i>EC Emergency control actions</i>												

T=TSO; P=PSO; G=Generators; N=Network devices; L=Load; D=Distributors; I=ISO

### II.1.4 Who provides these ancillary services?

The main providers of ancillary services are the generators. Network devices (voltage control) and large and/or interruptible customers (spinning and standing reserves).

	AT	BE	CZ	DK	FI	FR	DE	HU	IE	IR	NL	NO	PL	PT	ES	SE	SK	UK	
<b>FC</b>	G	G	G	G	G	G	GT	G	T		G	G	G	G	G	G	G	G	
<b>VC</b>	GN	GN	G	G	GT	G		G	T	GN	G	G	GN	GN	GN	T	G	G	G
<b>SP</b>	G	G	G	G	G	GL		G	T	GL	G	G	G		G	G	G	G	
<b>ST</b>			G	G	TL	G		G	T	G	G	GL	G	G		G	G	G	GL
<b>BS</b>	G	G	G	G	G	G		G	T	G	G		G			G	G	G	G
<b>RG</b>	G	G	G		G	G		G	T		G		G	G	G			G	
<b>GL</b>	G	GN	G		M	G		G	T	G				N			M		
<b>EC</b>	GN	G	T			G		GL	T	G	G								
<i>FC Frequency control</i>								<i>VC Voltage control</i>							<i>SP Spinning reserve</i>				
<i>ST Standing reserve</i>							<i>BS Black start capacity</i>							<i>RG Remote automatic generation control</i>					
<i>GL Grid loss compensation</i>							<i>EC Emergency control actions</i>												

T=TSO; P=PSO; G=Generators; N=Network devices; L=Load; D=Distributors; I=ISO; M=Market

## II.2 Structure of charges and costs

### II.2.1 What procurement / payment method is used?

There is no payment for frequency control in Austria (for primary), the Netherlands, Ireland, Iceland and Spain, since it is mandatory. Payment is based on negotiated contracts in Austria (secondary), Denmark, France, Hungary, Norway, Sweden and Finland. Open market and tendered bidding is used in the Czech Republic. In the UK the services are paid on a cost basis.

The voltage control is mandatory and unpaid in Sweden and Iceland. In the other countries it is paid under negotiated contracts or tariffs (UK, France, Spain, Finland).

The spinning reserve is mandatory and unpaid in Ireland and Iceland only. It is paid under negotiated contracts elsewhere.

The standing reserve is also mandatory and unpaid in Iceland. Besides the negotiated contracts in most countries, open market and tendered bidding is used in the Netherlands, the UK, Czech Republic, France and Norway.

The black start capacity is paid under negotiated contracts, except where it is obligatory (Ireland, Sweden and Iceland).

The remote generation control is mandatory in Iceland and paid under negotiated contracts elsewhere, with the exception of the Netherlands, where it depends on the choice of the generator.

The same for grid loss compensation, but the method of open market is used in the Netherlands, and tendering in France.

The emergency control actions are paid under negotiated contracts, except where they are mandatory (Iceland, Ireland).

	AT	BE	CZ	DK	FI	FR	DE	HU	IE	IR	NL	NO	PL	PT	ES	SE	SK	UK
<b>FC</b>	OM		M	N	N	NT	N O M	N	O	O	O	N	N	O	O	N	R	N
<b>VC</b>	OM		N	N	N	NT		N	O	R	N	N	N	ON	T	O	R	TN
<b>SP</b>			M	N	N	M		N	O	R	N	N			M	N	R	
<b>ST</b>			M	N	N	M		N	O	R	M	M	N	ON		N	R	M
<b>BS</b>	N		N	N				N	O	R	N		N			O	R	
<b>RG</b>	N		M		N			N	O					ON	M		R	
<b>GL</b>	N		M		N	M		N	O		M					N		
<b>EC</b>	N					O			O		N							
<i>FC Frequency control</i>						<i>VC Voltage control</i>						<i>SP Spinning reserve</i>						
<i>ST Standing reserve</i>						<i>BS Black start capacity</i>						<i>RG Remote automatic generation control</i>						
<i>GL Grid loss compensation</i>						<i>EC Emergency control actions</i>												

N=Negotiated contracts; O=Obligation, no payment; M=Open market; T=Tariff; R=Regulated price

## II.2.2 On what basis are the costs of ancillary services determined?

	AT	BE	CZ	DK	FI	FR	DE	HU	IE	IR	NL	NO	PL	PT	ES	SE	SK	UK	
<b>FC</b>	CW	LC	M		LWC	LWC		L					N			M	R	WL	
<b>VC</b>	CW		CW		LWC	LWC		L		R	M			N	LW	CW		R	
<b>SP</b>	CW	LC	M		LWC	M		L		R	M					N	M	R	
<b>ST</b>			M		LWC	M		C		R	M			N	LW		M	R	
<b>BS</b>	C	C	CW			LWC				R	M			N	LWC			R	WL
<b>RG</b>	CW	LC	M		LWC						M					N		R	
<b>GL</b>	N		M			M					M						M		
<b>EC</b>	CW										M								
<i>FC Frequency control</i>						<i>VC Voltage control</i>						<i>SP Spinning reserve</i>							
<i>ST Standing reserve</i>						<i>BS Black start capacity</i>						<i>RG Remote automatic generation control</i>							
<i>GL Grid loss compensation</i>						<i>EC Emergency control actions</i>													

C=Capital Cost; L=Lost Revenue; W=Wear and Tear; M=Open market; N=Contract price; R=Regulated prices

### II.2.3 How are prices for ancillary services defined?

The prices are negotiated/tendered in Austria, Finland, France, Hungary, Norway and the UK. They are regulated or fixed and monitored by regulator in Denmark, the Netherlands, Belgium, Ireland and Slovakia; and determined by market in the Czech Republic, Sweden and Spain.

	AT	BE	CZ	DK	FI	FR	DE	HU	IE	IR	NL	NO	PL	PT	ES	SE	SK	UK	
<b>FC</b>	NR	R	M	R	N	N	NM	N				N	N			M	R	C	
<b>VC</b>		R	C	R	N	N		N		R	R	N	N		R			R	N
<b>SP</b>	NR	R	N	R	N	N		N		R	R	N			M	M	R		
<b>ST</b>			M	R	N	N		N		R	R	M	N				M	R	N
<b>BS</b>	NR	R	C	R				R		R	R		N					R	C
<b>RG</b>	NR	R	M		N			N							M			R	
<b>GL</b>	NR		M			M		N			R						M		
<b>EC</b>	NR										R								
<i>FC Frequency control</i>						<i>VC Voltage control</i>						<i>SP Spinning reserve</i>							
<i>ST Standing reserve</i>						<i>BS Black start capacity</i>						<i>RG Remote automatic generation control</i>							
<i>GL Grid loss compensation</i>						<i>EC Emergency control actions</i>													

C=Cost Recovery; M=Open market; R=Regulated; N=Negotiated price;

### II.2.4 From whom is the price of ancillary services recovered?

The price (which of course constitutes costs for the TSO) is recovered from electricity end users in most countries, partly from generators in Austria and the Netherlands, and from both generators and end users in the UK.

In Ireland and the UK, suppliers are charged by the TSO, so the price is recovered from customers at the end of the day.

	AT	BE	CZ	DK	FI	FR	DE	HU	IE	IR	NL	NO	PL	PT	ES	SE	SK	UK	
<b>FC</b>	G	C	C	GC	C	C	C	C					C			N	C	GC	
<b>VC</b>	C	C	C	GC	C	C		C		S	GC			C	N	C		C	GC
<b>SP</b>	G		C	GC	C	N		C		S	GC			C		C	N	C	
<b>ST</b>			C	GC	C	N		C		S	GC			C	N		N	C	GC
<b>BS</b>	C	C	C	C						S	GC			C				C	GC
<b>RG</b>	G	C	C		C									C	N	C		C	
<b>GL</b>	C		C		GC	C					G	GC		C				GC	
<b>EC</b>						G					G	GC		C					
<i>FC Frequency control</i>						<i>VC Voltage control</i>						<i>SP Spinning reserve</i>							
<i>ST Standing reserve</i>						<i>BS Black start capacity</i>						<i>RG Remote automatic generation control</i>							
<i>GL Grid loss compensation</i>						<i>EC Emergency control actions</i>													

N=Network users; C=Customers; G=Generators; S=Suppliers

## II.2.5 By what mechanism is ancillary services price recovered?

There is uplift on transported kWhs in the Netherlands. The price is shared by non-eligible customers according to their consumption in Spain. In other countries, the System Tariffs are used to recover the price.

	AT	BE	CZ	DK	FI	FR	DE	HU	IE	IR	NL	NO	PL	PT	ES	SE	SK	UK
<b>FC</b>	T	T	T	T	T	T		T				T	T			T	C	T
<b>VC</b>	T	T	T	T	T	T		T		T	U	T	T	T	U		C	T
<b>SP</b>	T		T	T	T	I		T		T	UI	T	T		U	T	C	
<b>ST</b>			T	T	I	I		T		T	UI	T	T	T		I	C	I
<b>BS</b>	T	T	T	T				T		T	U		T				C	T
<b>RG</b>	T	T	T		T			T					T	T	U		C	
<b>GL</b>	T		T		T	T		T			U		T			T		
<b>EC</b>	T										UI		T					
<i>FC Frequency control</i>						<i>VC Voltage control</i>						<i>SP Spinning reserve</i>						
<i>ST Standing reserve</i>						<i>BS Black start capacity</i>						<i>RG Remote automatic generation control</i>						
<i>GL Grid loss compensation</i>						<i>EC Emergency control actions</i>												

T=System tariffs; I=System imbalance cost; U=Uplift; C=Customers share the price in accordance to consumption

## II.3 Metering and data management

In the Czech Republic and the UK the TSO monitors the ancillary services and generally is responsible for data management. There is extensive monitoring for Frequency Response, including the time taken to respond and the active power change which relates to the change in frequency. There is also a fee in the UK for the duration that the types of frequency response is instructed for. System monitoring is such that the TSO can issue warnings and remove generating units from the list of those to be paid if response is inadequate.

Reactive power is metered and paid accordingly. BS and less frequently utilised services are not metered but receive an availability fee. These services can be tested by being called by the TSO.

## II.4 Basis of selecting ancillary service providers

### II.4.1 On what basis do dispatchers select them?

The method used in all countries is to reach the minimum overall dispatch cost, taking the technical aspects into account, when and where necessary.

	AT	BE	CZ	DK	FI	FR	DE	HU	IE	IR	NL	NO	PL	PT	ES	SE	SK	UK
<b>FC</b>	1	D	T	D	N	D		N		ALL		ALL	N			D		DT
<b>VC</b>	T	T	T	D	TN	D		N		D	DT		N	T	T			DT
<b>SP</b>	1		P	D	N	P		N		D	DT	ALL			P	D		
<b>ST</b>			P	D	TN	P		N		D	DT	P	N	T		D		DT
<b>BS</b>	T	T	T	D		T		P		T	T		N					DT
<b>RG</b>	1	D	P		TN			N						T	P			
<b>GL</b>	1		P		P	D				ALL	D					D		
<b>EC</b>	T									ALL	T							
<i>FC Frequency control</i>						<i>VC Voltage control</i>						<i>SP Spinning reserve</i>						
<i>ST Standing reserve</i>						<i>BS Black start capacity</i>						<i>RG Remote automatic generation control</i>						
<i>GL Grid loss compensation</i>						<i>EC Emergency control actions</i>												

D=Minimum dispatch cost; P=Best price; T=Technical considerations; N=Contract price; ALL=All generators participate; 1=One contracted partner.

## II.5 Experiences of existing systems

Generally it is necessary to collect more experience and gain satisfying knowledge on how ancillary services work in *market conditions*. One of the mentioned problems concerns **the principles of functioning** of ancillary services and their relations to each other. Another problem often raised is the **inadequate level of payments** for ancillary services.

### II.5.1 Incentives to ensure that future needs are met

Where any “incentives” exist, they are obligations/requirements for generators that want to sell electricity to the TSO. They are put on generators in Austria, the Netherlands, France, Hungary, Ireland, the UK and Iceland. In the latter country, contracts are signed with heavy industry customers for providing ancillary services. In Spain, a so-called capacity payment is received by generators that can run at least 180 hours a year at maximum load.

### II.5.2 Other System Support contracts in use

<b>Belgium</b>	Co-ordinating contract for adjusting the operational plan of a generator on the request of TSO.
<b>Denmark</b>	TSO can impose restrictions on generators to avoid overloading transmission lines.
<b>Hungary</b>	Rescheduling maintenance (generator gets bonus if the generator reschedules programme of scheduled maintenance at the request of TSO), Increased peak period capacity (generator gets bonus if the generator operates greater capacity than its declared tested capacity at the request of TSO during the peak period demand), Reduced off-peak period capacity (generator gets bonus if the generator operates at a capacity which is less than the declared minimum capacity at the request of TSO during the off-peak period demand).
<b>Iceland</b>	Peak shaving is included in the contract with one heavy industry customer.
<b>Slovakia</b>	Grid loss compensation is not considered an ancillary service; however, it is regulated, and provided on a contractual basis between generators and TSO.
<b>Sweden</b>	For secondary control.

### II.5.3 How long has the current system been used?

 over 10 years  
*United Kingdom*

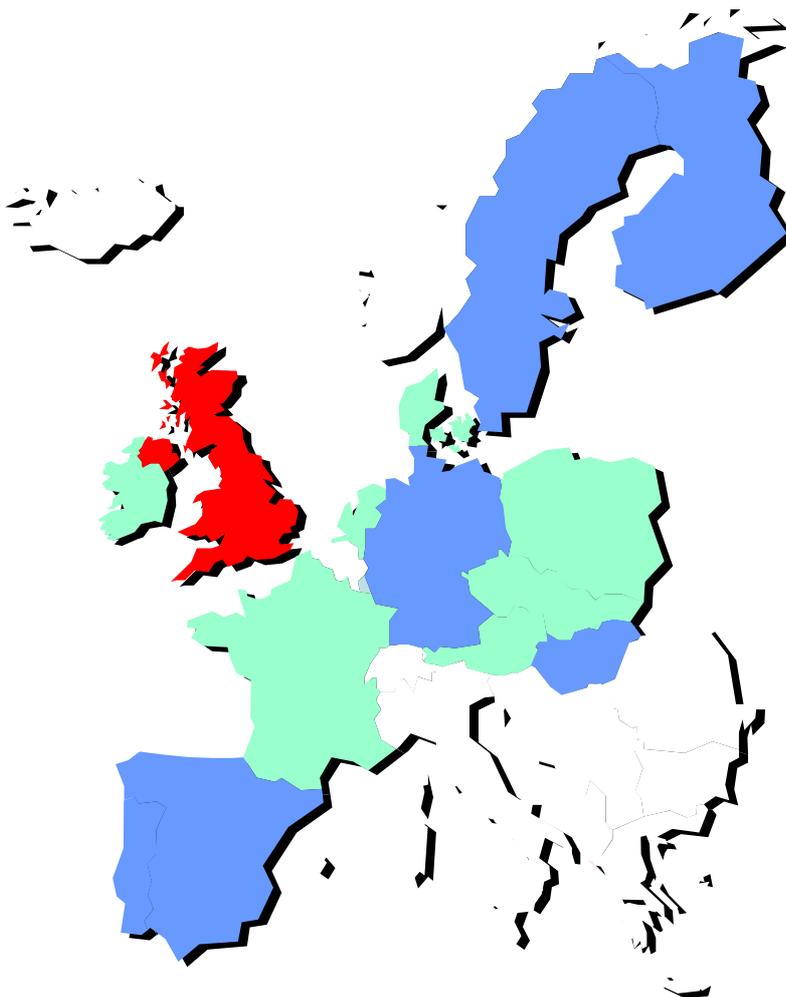
 5 to 10 years

*Finland  
Germany  
Hungary  
Portugal  
Spain  
Sweden*

 2 to 5 years

*Austria  
Czech Republic  
Denmark  
France  
Ireland  
Netherlands  
Poland  
Slovakia*

 less than 2 years (or no answer)



### II.5.4 Problems experienced with the current system

Four countries declared that they have no problems with the currently used system (Austria, Denmark, the Netherlands and Portugal).

<b>Germany</b>	The experience is not enough yet.
<b>France</b>	The experience is not enough yet.
<b>Hungary</b>	The incentives are not enough for the providers.
<b>Ireland</b>	Market. It is an early stage of development but current ancillary service prices do not reflect the costs of providing the services.
<b>UK</b>	There had been an issue of how to compensate generators for imbalance, penalised under NETA <sup>2</sup> , which is caused by (mandatory) frequency response. This was resolved in early 2003 by quantifying the frequency response energy volume and treating it separately.
<b>Sweden</b>	Economical incentives to develop voltage control are missing (negotiations already started to create a market for reactive power). No incentives for investments.
<b>Finland</b>	The level of payment is too low compared to actual costs for generators. The imbalance, caused by frequency response, is not compensated.

<sup>2</sup> NETA – New Electricity Trading Arrangements

<b>Spain:</b>	<p>Tertiary regulation bids must have a ramp time less than 15 minutes and be maintainable for two hours. There is no special mechanism to check these characteristics. Rules to calculate the amount of tertiary reserve that must be dispatched at any point in time must be developed.</p> <p>Regulating energy is paid by those who deviate and proportionally to the absolute value of the deviation. The price depends on the whole of the deviations of all participants. No final wholesale price of electricity.</p> <p>For voltage control, the procedure presents a non-competitive service based on payment of a measured service subject to non-following considerations and rated at an approved tariff. The time-of-delivery issue in reality differentiates the quality of service. This characteristic will eventually be considered.</p>
<b>Czech Republic</b>	<p>In an early stage of the market, current ancillary service prices in some cases do not reflect the costs of providing the services. Regulating energy is paid by those who deviate. The price depends on the whole of the deviations of all participants. No final wholesale price of electricity.</p>
<b>Slovakia</b>	<p>The system of ancillary services is under progress year by year.</p>

### **II.5.5 Comments**

The Netherlands and also Denmark announced concerns about how the system would work if there is no overcapacity on the market anymore.

### **III. EURELECTRIC'S VIEWS**

#### **III.1 What should be considered ancillary services?**

For the purposes of this report, EURELECTRIC uses a set of definitions as provided in Chapter **I.2** *Description of individual ancillary services*.

Irrespective of being mandatory or not, the following services should *minimally* be considered ancillary services:

- frequency control
- voltage control
- spinning reserve
- standing reserve
- black start capacity
- remote automatic generation control
- emergency control action.

Beyond this scope, several other ancillary services can be considered and used in different countries.

#### **III.2 Necessity for common definitions and/or common rules?**

At least common definitions are necessary to make trading with ancillary services through borders possible. How cross-border trading with ancillary services is feasible in principle is a question of technical possibilities. In the case of ancillary services that are not restricted by definition to the physical structure of the local grid (to the territory of TSO where the provider is located), common rules are necessary beyond common definitions.

#### **III.3 Classification of ancillary services**

To maintain a stable operating state of the transmission system, the following actions are needed:

1. to control the frequency of the system
2. to control the voltage of the system
3. to control the stability of the system
4. to control the load of the network
5. to restart the system in certain circumstances.

These *system needs* could be satisfied using the following ancillary services (the control of network load is handled by other means than ancillary services):

*Maintaining frequency*

- frequency control
- spinning reserve
- remote automatic generation control
- emergency control actions.

*Maintaining voltage*

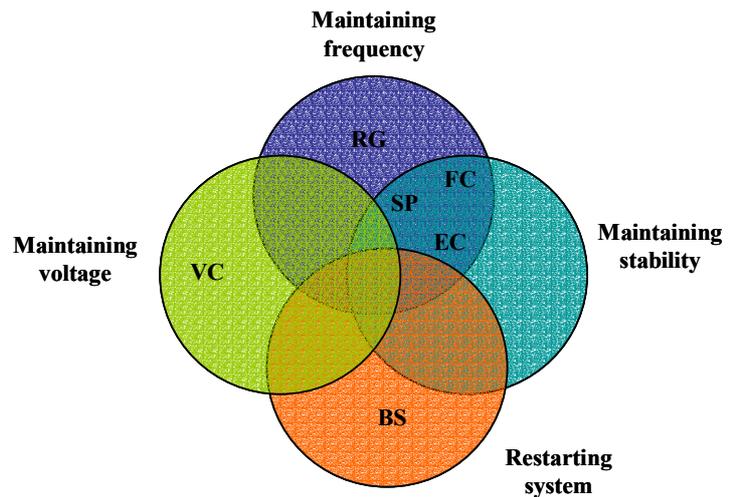
- voltage control.

*Maintaining stability*

- frequency control
- spinning reserve
- emergency control actions.

*Restarting system*

- black start capacity.



A theoretically possible step towards making the ancillary services market simpler is procuring not the ancillary services directly, but ‘ancillary service packages’ to satisfy certain system needs. In this case the product is not frequency control and/or spinning reserve separately, but a ‘maintaining frequency service’.

Another possible classification of ancillary services can be based on their relation to the *system stability*, grouping them into:

<u>NORMAL OPERATION</u>	<u>FAILURE PREVENTION</u>	<u>SYSTEM RESTORATION</u>
frequency control	spinning reserve	black start capability
voltage control	standing reserve	
remote automatic generation control	emergency control action	
grid loss compensation		

### III.4 Which ancillary services should be mandatory?

To continuously ensure the quality of electricity provided for customers, the following ancillary services should be mandatory for each dispatchable generator:

- frequency control
- voltage control
- emergency control action.

The ability of a generator to provide other ancillary services is strongly dependent on technical/technological considerations. In any case, no ancillary service other than listed above should be mandatory. In case a generator is not able to provide the mandatory ancillary services, it should be allowed to contract for it – however, the provision must be ensured.

Obligations for capability for providing certain ancillary services could play as barriers in an open market (e.g. a generator is obliged to reserve its spinning reserve, although it might be able to sell it in the market).

Another possible approach is to leave provision of all ancillary services fully to an open market. In this case, no ancillary service should be mandatory on any generator.

EURELECTRIC can not accept a situation where certain generators are obliged to provide certain ancillary services, while others are not.

### III.5 Which ancillary services can/should be procured in a competitive manner?

The general view is that as many – non mandatory – ancillary services should be procured under market conditions as possible. However the locational nature of certain ancillary services (e.g. reactive power) should be fully recognised.

In *emergency situation*, it can be necessary to authorise the system operators to demand ancillary services, whose provision is mandatory for generators, ensuring that adequate compensation is provided.

### III.6 Which ancillary services should be paid for and how?

All ancillary services should be paid for since provision invariably incurs economic costs.

Dependent on the ancillary service in question, there can be three types of “deliveries” from an ancillary service provider:

1. ability to provide a service;
2. readiness to provide the service when necessary;
3. actual provision of the service when and as necessary.

The **ability** of a provider to provide an ancillary service can be defined on a technical basis and can be expressed in a form of a license or certificate. If a generator is obliged to be able to provide an ancillary service, its costs should be recoverable. If it is a generator’s own decision to build in the ability to provide an ancillary service, it should be considered as a market-based decision and covered by the generator itself.

The **readiness** to provide a particular ancillary service can often run counter to electricity production or the flexibility of the plant (e.g. keeping spinning reserve can lead to decreased production). Hence, providers should be paid for it, e.g. in a form of a permanent fee.

The payment for the actual **provision** of ancillary services should be based on the market value of the alternative.

Some ancillary services (i.e. black start capacity, remote automatic generation control, emergency control action) need longer contracts (e.g. a year), others can be procured on a daily or shorter basis (spinning reserve, standing reserve). Taking it into account, ancillary services can be paid as follows:

- frequency control: negotiated or auctioned contracts
- voltage control: negotiated or auctioned contracts
- spinning reserve: open market with bidding
- standing reserve: open market with bidding
- black start capacity: negotiated or auctioned contracts
- remote automatic generation control: negotiated or auctioned contracts
- emergency control action: negotiated or auctioned contracts.

EURELECTRIC can also envisage a situation where all ancillary services are subject to open market, provided that the market is adequately liquid.

It is worth noting that some countries, basically those with more developed ancillary services markets, consider the payment for ancillary services adequate; others, where more or all ancillary services are mandatory, often deem the payments not covering the costs of providing these services.

### **III.7 How to recover the costs of ancillary services?**

Since the ancillary services are used to ensure a certain quality of electricity provided for the customers, the cost of ancillary services should be recovered from the suppliers who in turn should recover it from end-users. From that, the system operator has to pay the generators who provide ancillary services and to cover the cost of those ancillary services provided by its own services/equipment. Would ancillary services be needed due to an identifiable cause, the principle “causer pays” should be applied.

### **III.8 Should regional markets for ancillary services develop?**

This depends greatly on the technical profiles of ancillary services. Some of them are physically tied to the actual system, making any kind of outbound trade impossible; others have direct geographical aspects, which means that they cannot be traded through big distances and several borders. Nevertheless, in an open and single European market, the political borders should not restrict the flow of ancillary services. It is the market that should create its own pliable borders, acknowledging the technical and economic aspects.

Actual trading of ancillary services, where and to the extent it is technically feasible, could/should happen between – or at least *through* – TSOs only, who need to be fully aware of the actual set and volume of ancillary services they can dispose over.

The cross-border trade of ancillary services could prove a great business opportunity. However, it also depends on the interconnection capacity.

EURELECTRIC can envisage cross-border trade of the following ancillary services, as far as it is technically feasible and the corresponding UCTE rules and standards allow them:

- frequency control
- spinning reserve
- standing reserve
- black start capacity.

### **III.9 Do ancillary services need regulation?**

Beyond the regulation which determines the quality of electricity provided, the natural monopoly system operator needs to be strictly regulated in defining requirements and ancillary service provision obligations for generators and network users. The regulation must allow providers to sell ancillary services under market conditions where it is technically feasible. Would the provision of ancillary service in question be mandatory or market-based procurement not feasible, the regulation must allow the provider of ancillary services to fully recover its cost (cost of ancillary services) from the payment received from the system operator.

### **III.10 How to ensure ancillary services in the future?**

In the existing systems, the simplest method is used mostly: the generator that wants to join the electricity market must be able to provide certain ancillary services.

Using a general set of obligations for all generators could make some of them unable to join the market (e.g. black start capacity obligation for a nuclear power plant, etc.). If the obligations are adjusted to the different types of generators with different technical capabilities, the sustainable provision with all ancillary services necessary could be endangered. In this case, the ensuring all needed ancillary services means indirectly defining the mixture of generating technologies in the market.

On the other side, power systems need ancillary services to maintain the quality of electricity. Assuming the increasing share of certain renewables and distributed generation in the market, it could get harder and harder to find generators that (together) can provide all the necessary ancillary services.

A solution can be drawn envisaging a market for ancillary services with prices high enough to influence investment decisions, encouraging the construction of those plants, which are able to provide certain ancillary services, and to lead to innovations. That market must ensure fair competition and adequately balance risks. If distortions are introduced with imposing uneven obligations on generators, EURELECTRIC fears the ancillary services market will not meet the expectations, which in turn can lead to the failure of the electricity market, too.

Worth mentioning that certain legislation on different areas can affect the ancillary services market. E.g. the implementation process of the Water Framework Directive can easily result in decreasing the ability of storage hydro plants to provide ancillary services.

## IV. CONCLUSIONS

The design of ancillary services market largely differs from country to country, from region to region, and even within countries. The differences are present due to the different levels of development of the electricity markets as well as to many other factors.

The energy and the ancillary services markets are highly interdependent. Providers are facing new challenges, where they need to find a balance between selling electricity and providing ancillary services (e.g. providing reserve can run counter to selling electricity and vice versa). This is one of the reasons why it is essential to develop markets for ancillary services in parallel with opening the market for electricity.

EURELECTRIC would like to emphasise, as a general principle, that generators should be adequately paid for all “deliveries” (see Chapter III.6) they are obliged to provide.

Developing ancillary services markets raises several new questions:

- Should EU-wide definitions of ancillary services, or even common rules for providing and procuring them be developed (in close correspondence with relevant UCTE rules)?
- How to measure real-time delivery of ancillary services?
- Should there be a single market for ancillary services or separate markets for each (or for “batches” of services)?
- How flexible can system operators be in purchasing ancillary services in liberalised market conditions?
- How flexible can system operators be in use of resources (use of high-value resource for low-value functions, if cheaper)?
- How to ensure ancillary services in the future?

EURELECTRIC has not tried to find comprehensive and exhaustive answers to these questions, but deems it necessary and timely to raise them. As the union of the European electricity industry, EURELECTRIC is ready to participate in discussions and work aiming at answering these questions.

## ANNEX I - QUESTIONNAIRE

### Section A

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General data.

### Section B

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Covered ancillary services:

- Frequency Control
- Voltage Control/Reactive Power
- Spinning Reserve
- Standing Reserve
- Black Start Capacity
- Remote Automatic Generation Control (AGC) for Power Balancing
- Grid Loss Compensation (energy)
- Emergency Control Actions
- Other

#### **B1)**

What are considered ancillary services in your country?

Give a brief description of each, including the type mainly used (e.g. local or centralised control).

#### **B2)**

Is it mandatory? On whom?

#### **B3)**

Who procures these ancillary services?

(e.g. XYZ Transmission System Operator / Power Exchange)

#### **B4)**

Who provides these ancillary services?

(e.g. Generators, Demand, Network Devices)

#### **B5)**

What procurement / payment method is used?

(e.g. Negotiated Contracts, Obligation / Penalty, Open Market Bidding)

#### **B6)**

How are charges for Ancillary Services determined?

(e.g. Set by Government, Regulated, Private Contract, Tendered Contract, Spot Market, Cost Recovery)

**B7)**

If Cost Recovery, what are the costs based on?  
(e.g. Lost Revenue, Wear and Tear, Capital costs)

**B8)**

From whom are the costs recovered?  
(e.g. Generators, Customers)

**B9)**

How are Ancillary Services costs recovered?  
(e.g. Use of System Tariffs, "Uplift")

**B10)**

On what basis do dispatchers select them?  
(e.g. overall minimum dispatch cost, contract price)

**Section C**

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**C1)**

Describe the incentives to ensure that future needs are met.  
(e.g. licence obligations, incentive schemes)

**C2)**

Do you have other System Support contracts?  
(e.g. with Generators to cater for transmission constraints that are a feature of your market)  
If so, please describe and specify the contracting parties.

**C3)**

What is the cost of Ancillary Services as a % of your total End-User price?

**Section D**

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**D1)**

How long has the current system of procuring and paying for ancillary services been used in your country?

**D2)**

What problems have you experienced?

**D3)**

Are there plans for major change regarding ancillary services in the future?

**D4)**

Any other comments on the effectiveness of your approach to Ancillary Services?

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## AUSTRIA

### What are considered ancillary service in your country?

<b>Frequency control:</b>	Yes. Primary frequency control - is mandatory for generating units >5MW; secondary frequency control - centralised control - by the TSO
<b>Voltage control / reactive power:</b>	Yes. Centralised control - by the TSO.
<b>Spinning reserve:</b>	No. Part of frequency control: centralised control - by the TSO.
<b>Standing reserve:</b>	No.
<b>Black start capacity:</b>	No. Part of emergency control actions: centralised control - by the TSO.
<b>Remote automatic generation control:</b>	No. Part of frequency control: centralised control - by the TSO.
<b>Grid loss compensation:</b>	Yes. Centralised control - by the TSO.
<b>Emergency control action:</b>	Yes. Centralised control - by the TSO.
<b>Other:</b>	No.

### Is it mandatory? On whom?

<b>Frequency control:</b>	Yes. Primary frequency control - is mandatory for generating unit >5MW; secondary frequency control - mandatory for the TSO.
<b>Voltage control / reactive power:</b>	Yes. Supply is mandatory for the TSO (controllable reactive sources, tap changing on grid supply transformers); all generating units must be able to achieve a machine reactive capability of 0.9 pf lag and 0.9pf lead.
<b>Spinning reserve:</b>	Yes. Primary frequency control - is mandatory for generating unit >5MW; secondary frequency control - mandatory for the TSO.
<b>Black start capacity:</b>	Yes. Mandatory for the TSO.
<b>Remote automatic generation control:</b>	Yes. Secondary frequency control - mandatory for the TSO.
<b>Grid loss compensation:</b>	Yes. Mandatory for the TSO.
<b>Emergency control action:</b>	Yes. Mandatory for the TSO.

### Who procures these ancillary services?

<b>Frequency control:</b>	Secondary frequency control - TSO.
<b>Voltage control</b>	TSO

<b>/ reactive power:</b>	
<b>Standing reserve:</b>	TSO
<b>Black start capacity:</b>	TSO
<b>Remote automatic generation control:</b>	TSO.
<b>Grid loss compensation:</b>	TSO
<b>Emergency control action:</b>	TSO

---

**Who provides these ancillary services?**

<b>Frequency control:</b>	Generators
<b>Voltage control / reactive power:</b>	Network devices, generators.
<b>Spinning reserve:</b>	Generators
<b>Black start capacity:</b>	Hydro power generators
<b>Remote automatic generation control:</b>	Hydro power generators
<b>Grid loss compensation:</b>	Generators
<b>Emergency control action:</b>	Network devices, generators

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**What procurement / payment method is used?**

<b>Frequency control:</b>	Primary frequency control -obligation; secondary frequency control - negotiated contracts; TSO with generators.
<b>Voltage control / reactive power:</b>	Power factor 0.9 capability of all generating units - obligation; supply obligation for the TSO, sources; devices - negotiated contracts.
<b>Spinning reserve:</b>	Primary frequency control -obligation; secondary frequency control - negotiated contracts; TSO with generators.
<b>Black start capacity:</b>	Part of emergency control actions - negotiated contracts; TSO with generators.
<b>Remote automatic generation control:</b>	Part of secondary frequency control - negotiated contracts; TSO with generators
<b>Grid loss compensation:</b>	Negotiated contracts; TSO with generators

<b>Emergency control action:</b>	Obligation for TSO; TSO use negotiated contracts (generators) to manage these requirements
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**How are charges for ancillary services determined?**

<b>Frequency control:</b>	Negotiated contracts - monitoring of price and condition by the regulator (office)
<b>Spinning reserve:</b>	Negotiated contracts - monitoring of price and condition by the regulator (office)
<b>Black start capacity:</b>	Negotiated contracts - monitoring of price and condition by the regulator (office)
<b>Remote automatic generation control:</b>	Negotiated contracts - monitoring of price and condition by the regulator (office)
<b>Grid loss compensation:</b>	Negotiated contracts - monitoring of price and condition by the regulator (office)
<b>Emergency control action:</b>	Negotiated contracts - monitoring of price and condition by the regulator (office)

**If Cost Recovery, what are the costs based on?**

<b>Frequency control:</b>	Capital costs; Wear and Tear
<b>Voltage control / reactive power:</b>	Capital costs; Wear and Tear
<b>Spinning reserve:</b>	Capital costs; Wear and Tear
<b>Black start capacity:</b>	Capital costs
<b>Remote automatic generation control:</b>	Capital costs; Wear and Tear
<b>Grid loss compensation:</b>	Contract price
<b>Emergency control action:</b>	Capital costs; Wear and Tear

**From whom are the costs recovered?**

<b>Frequency control:</b>	Generators
<b>Voltage control / reactive power:</b>	Customers
<b>Spinning reserve:</b>	Generators
<b>Black start capacity:</b>	Customers
<b>Remote automatic generation control:</b>	Generators

**Grid loss compensation:** Customers

**How are ancillary services costs recovered?**

<b>Frequency control:</b>	Primary control - obligation - no payment; secondary control - System Tariffs
<b>Voltage control / reactive power:</b>	System Tariffs
<b>Spinning reserve:</b>	System Tariffs
<b>Black start capacity:</b>	System Tariffs
<b>Remote automatic generation control:</b>	System Tariffs
<b>Grid loss compensation:</b>	System Tariffs
<b>Emergency control action:</b>	System Tariffs

**On what basis do dispatchers select them?**

<b>Frequency control:</b>	Secondary control – only one contract partner
<b>Voltage control / reactive power:</b>	Operation is based on technical aspects, minimum grid loss
<b>Spinning reserve:</b>	Secondary control - only one contract partner
<b>Black start capacity:</b>	Operation is based on technical aspects
<b>Remote automatic generation control:</b>	Secondary control – only one contract partner
<b>Grid loss compensation:</b>	Secondary control – only one contract partner
<b>Emergency control action:</b>	Operation is based on technical aspects

**Describe the incentives to ensure that future needs are met**

Monitoring by the regulator (office)

**Other System Support contracts?**

No

**What is the cost of ancillary services as a % of your total end-user price?**

The Austrian grid tariff is based on federal structure of Austria and consists of 7 regional different grid levels (complex system). Level 1 is the highest voltage - network charges of end-users differ according to the regional tariffs and the connection voltage level. The grid tariff is divided into a gross (40%) and net component (60%). The cost of ancillary services is approximately 30% including grid loss compensation. Percentage is an estimated overall value for level 1 charges

**How long has the current system of procuring and paying for ancillary services been used in your country?**

Since 1999

**What problems have you experienced?**

None

**Are there plans for major change regarding ancillary services in the future?**

Invitation of secondary control services - no details available

## BELGIUM

### What are considered ancillary service in your country?

<b>Frequency control:</b>	Yes
<b>Voltage control / reactive power:</b>	Yes
<b>Spinning reserve:</b>	Yes. Tertiary reserve together with Standing reserve
<b>Standing reserve:</b>	Yes. Tertiary reserve together with Spinning reserve
<b>Black start capacity:</b>	Yes
<b>Remote automatic generation control:</b>	Yes
<b>Grid loss compensation:</b>	No
<b>Emergency control action:</b>	No
<b>Other:</b>	Yes. Constraint management and Unbalancing 1/4h base

### Is it mandatory? On whom?

<b>Frequency control:</b>	Yes - by law – grid code
<b>Voltage control / reactive power:</b>	Yes - by law – grid code
<b>Spinning reserve:</b>	Yes - by law – grid code
<b>Standing reserve:</b>	Yes - by law – grid code
<b>Black start capacity:</b>	Yes - by law – grid code
<b>Remote automatic generation control:</b>	Yes - by law – grid code
<b>Grid loss compensation:</b>	Yes - by law – grid code
<b>Emergency control action:</b>	Yes - by law – grid code
<b>Constraint management and Unbalancing 1/4h base:</b>	Yes - by law – grid code

**Who procures these ancillary services?**

<b>Frequency control:</b>	TSO
<b>Voltage control / reactive power:</b>	TSO
<b>Spinning reserve</b>	TSO
<b>Standing reserve:</b>	TSO
<b>Black start capacity:</b>	TSO
<b>Remote automatic generation control:</b>	TSO
<b>Emergency control action:</b>	TSO
<b>Constraint management and Unbalancing 1/4h base:</b>	TSO

**Who provides these ancillary services?**

<b>Frequency control:</b>	Generators
<b>Voltage control / reactive power:</b>	Network devices, generators
<b>Spinning reserve:</b>	Generators
<b>Standing reserve:</b>	Generators
<b>Black start capacity :</b>	Generators
<b>Remote automatic generation control:</b>	Generators
<b>Grid loss compensation:</b>	Each Access Responsible Party
<b>Emergency control action:</b>	Generators
<b>Constraint management and Unbalancing 1/4h base:</b>	Generators

**What procurement / payment method is used?**

<b>Frequency con-</b>	To be determined
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<b>trol:</b>	
<b>Voltage control / reactive power:</b>	To be determined
<b>Spinning reserve:</b>	To be determined
<b>Standing reserve:</b>	To be determined
<b>Black start capacity:</b>	To be determined
<b>Remote automatic generation control:</b>	To be determined
<b>Constraint management and Unbalancing 1/4h base:</b>	To be determined

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**How are charges for ancillary services determined?**

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<b>Frequency control:</b>	Regulated
<b>Voltage control / reactive power:</b>	Regulated
<b>Spinning reserve:</b>	Regulated
<b>Standing reserve:</b>	Regulated
<b>Black start capacity:</b>	Regulated
<b>Remote automatic generation control:</b>	Regulated
<b>Constraint management and Unbalancing 1/4h base:</b>	Regulated

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**If Cost Recovery, what are the costs based on?**

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<b>Frequency control:</b>	Lost Revenue and Capital Cost
<b>Voltage control / reactive power:</b>	Benchmark with network devices
<b>Spinning reserve:</b>	Lost Revenue and Capital Cost
<b>Standing reserve:</b>	Lost Revenue and Capital Cost

<b>Black start capacity:</b>	Capital costs
<b>Remote automatic generation control:</b>	Lost Revenue and Capital Cost

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**From whom are the costs recovered?**

<b>Frequency control:</b>	Customers
<b>Voltage control / reactive power:</b>	Customers
<b>Black start capacity:</b>	Customers
<b>Remote automatic generation control:</b>	Customers
<b>Constraint management and Unbalancing 1/4h base:</b>	Customers

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**How are ancillary services costs recovered?**

<b>Frequency control:</b>	Use of System Tariffs
<b>Voltage control / reactive power:</b>	Use of System Tariffs
<b>Spinning reserve:</b>	To be determined
<b>Standing reserve:</b>	To be determined
<b>Black start capacity:</b>	Use of System Tariffs
<b>Remote automatic generation control:</b>	Use of System Tariffs
<b>Constraint management and Unbalancing 1/4h base:</b>	Use of System Tariffs

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**On what basis do dispatchers select them?**

<b>Frequency control:</b>	Minimum dispatch cost
<b>Voltage control / reactive power:</b>	On demand, TSO
<b>Black start capacity:</b>	On demand, TSO

<b>Remote automatic generation control:</b>	Minimum dispatch cost
<b>Constraint management and Unbalancing 1/4h base:</b>	On demand, TSO

**Describe the incentives to ensure that future needs are met**

To ensure TSO that generators provide the contracted ancillary services, different incentive schemes could be taken into consideration. Belgian grid code also says that whenever the generators signal their incapacity to deliver ancillary services ( partial or total ) he can claim the necessary means he estimates necessary

**Other System Support contracts?**

In order to assure the safety, reliability and efficiency of the whole grid system TSO can change operational production planning of the generators. Those interventions are foreseen in the so-called “Co-ordination contract”. Information exchange between TSO and generator talks place on different time scales: for revisions: yearly, for operational aspects: Week-10, Week-1, day ahead, intra day. Each party can ask to make changes (may not run status, must run status, incremental/decremental bids, etc.).

**What is the cost of ancillary services as a % of your total end-user price?**

Actual cost is reflected in the tariff system based on a fee according the voltage level off the end user. In this actual system the grid losses are included. According to the grid code specifications , where grid losses are no longer considered as an ancillary service , a fee of 2.5 €/MWh is expected for all end users.

**How long has the current system of procuring and paying for ancillary services been used in your country?**

Although some elements of the system are operational under a technical point of view, procuring and paying elements are still under negotiation

## DENMARK

### What are considered ancillary service in your country?

<b>Frequency control/</b>	Yes. The frequency control is performed by the primary control of the central power units. The units are divided in to groups, one group with a deadband of 0-50 mHz and one group with a deadband of 150 mHz. The principal of control used is modified sliding pressure, but condensate throttling control is also used.
<b>Voltage control / reactive power/</b>	Yes. The two system operators have the responsibility for the voltage stability. Voltage control is performed by the cobbling of static VAr compensators combined with the change of magnetising on the generators of the central production units.
<b>Spinning reserve/</b>	Yes. The two system operators have the responsibility to keep the power balance in each of the grid areas. The central power units supply spinning reserve (potential increase/decrease in active power production). On future wind power plants ordered decrees in production can be performed. Apart from spinning reserve fast reserve is offered which includes: Overload, extra reserve due to reduction of head production (supplying the heat consumers from a hot water accumulating tank)
<b>Standing reserve/</b>	Yes. The two system operators have the responsibility to keep the power balance in each of the grid areas. The central power units supply standing reserve.
<b>Black start capacity/</b>	No. The two system operator insures that there is available black start capacity at any time. This is not considered as ancillary services.
<b>Remote automatic generation control:</b>	No. AGC is not used in Denmark but may be used in the future. Some automatic control of the power flow in the HVDC connections between Denmark, Norway and Sweden is performed but mainly for emergency control actions and not for power balancing. This is not considered as ancillary services.
<b>Grid loss compensation:</b>	No. Electricity producers and electricity consumers pay the system operator a tariff per MWh produced or consumed electricity. This covers the administration and operation costs for the grid including grid loss. This is not considered as ancillary services.
<b>Emergency control action:</b>	No. AGC on the HVDC connections to Norway and Sweden. This is not considered as ancillary services.
<b>Other:</b>	No.

### Is it mandatory? On whom?

<b>Frequency control:</b>	Yes. It is mandatory for the two system operators (Eltra and Elkraft System) to contribute with frequency control (primary control) in each of their areas with a contribution that is proportional to the electricity consumption in the area in relation to the consumption in the total frequency area (UTCE or Nordel). It is only the two main power production companies that have the technical potential to offer primary control and therefore it is mandatory for them to participate in frequency control. In the future there might be established open marked for frequency control where smaller decentralised power plants can offer control potential.
<b>Voltage control / reactive power:</b>	Yes. It is mandatory for the two system operators (Eltra and Elkraft System) to keep the voltage stability.
<b>Spinning reserve:</b>	Yes. It is mandatory for the two system operators (Eltra and Elkraft System) to keep the power balance.
<b>Standing re-</b>	Yes. It is mandatory for the two system operators (Eltra and Elkraft System) to

serve: | keep the power balance as well as the necessary conditions for open market.

**Who procures these ancillary services?**

<b>Frequency control:</b>	The two main power productions company
<b>Voltage control / reactive power:</b>	The two system operators use their own static VAr compensators. In addition to that the two main power production companies contribute with voltage control by magnetisation of the generators.
<b>Spinning reserve:</b>	The two main power production companies.
<b>Standing reserve:</b>	The two main power production companies.

**Who provides these ancillary services?**

<b>Frequency control:</b>	Generators.
<b>Voltage control / reactive power:</b>	Generators and static VAr compensators.
<b>Spinning reserve:</b>	Generators.
<b>Standing reserve:</b>	Generators.

**What procurement / payment method is used?**

<b>Frequency control:</b>	Negotiated contracts.
<b>Voltage control / reactive power:</b>	Negotiated contracts.
<b>Spinning reserve:</b>	Partly open marked bidding (with some limits of the bids because the marked is not fully open).
<b>Standing reserve:</b>	Negotiated contracts.

**How are charges for ancillary services determined?**

<b>Frequency control:</b>	Fixed yearly payment is agreed between the system administrator and the main power company as a part of a grater ancillary service contract containing elements of voltage control, spinning reserve capacity guaranties and standing reserve guaranties. They are in some way in a monopoly situation and payment for ancillary services is agreed in a negotiated contract between the system operator and the Power Company. A department fore monopoly inspection controls the contracts.
<b>Voltage control / reactive power:</b>	Fixed yearly payment is agreed between the system administrator and the main power company as a part of a grater ancillary service contract containing elements of voltage control, spinning reserve capacity guaranties and standing reserve guaranties. They are in some way in a monopoly situation and payment for ancillary services is agreed in a negotiated contract between the system operator and the Power Company. A department fore monopoly inspection controls the contracts.
<b>Spinning re-</b>	Fixed yearly payment is agreed between the system administrator and the main

<b>serve:</b>	<p>power company as a part of a grater ancillary service contract containing elements of voltage control, spinning reserve capacity guaranties and standing reserve guaranties.</p> <p>They are in some way in a monopoly situation and payment for ancillary services is agreed in a negotiated contract between the system operator and the Power Company. A department fore monopoly inspection controls the contracts.</p> <p>The payment includes a yearly capacity payment and a payment for the actual use of MWh of the spinning reserve. Each day the Power Company informs the system operator about offer prizes for regulation power. Some of this marked is not considered to be totally open and therefor the offer prizes is restricted to an upper limit related to the market price of the ordinary electricity marked.</p>
<b>Standing reserve:</b>	<p>Fixed yearly payment is agreed between the system administrator and the main power company as a part of a grater ancillary service contract containing elements of voltage control, spinning reserve capacity guaranties and standing reserve guaranties.</p> <p>They are in some way in a monopoly situation and payment for ancillary services is agreed in negotiated contracts between the system operator and the Power Company. A department fore monopoly inspection controls the contracts.</p>

#### **From whom are the costs recovered?**

<b>Frequency control:</b>	The electricity producers and electricity consumers.
<b>Voltage control / reactive power:</b>	The electricity producers and electricity consumers.
<b>Spinning reserve:</b>	The electricity producers and electricity consumers.
<b>Standing reserve:</b>	The electricity producers and electricity consumers.
<b>Black start capacity:</b>	The electricity producers and electricity consumers.
<b>Remote automatic generation control:</b>	The electricity producers and electricity consumers.
<b>Grid loss compensation:</b>	The electricity producers and electricity consumers.
<b>Emergency control action:</b>	The electricity producers and electricity consumers.

#### **How are ancillary services costs recovered?**

<b>Frequency control:</b>	Use of system tariffs. The consumers and the producers pay a certain amount per MWh according to the network voltage level in the feeding/delivery point.
<b>Voltage control / reactive power:</b>	Use of system tariffs. The consumers and the producers pay a certain amount per MWh according to the network voltage level in the feeding/delivery point.
<b>Spinning reserve:</b>	Use of system tariffs. The consumers and the producers pay a certain amount per MWh according to the network voltage level in the feeding/delivery point.
<b>Standing reserve:</b>	Use of system tariffs. The consumers and the producers pay a certain amount per MWh according to the network voltage level in the feeding/delivery point.
<b>Black start</b>	Use of system tariffs. The consumers and the producers pay a certain amount per

<b>capacity:</b>	MWh according to the network voltage level in the feeding/delivery point.
<b>Remote automatic generation control:</b>	Use of system tariffs. The consumers and the producers pay a certain amount per MWh according to the network voltage level in the feeding/delivery point.
<b>Grid loss compensation:</b>	Use of system tariffs. The consumers and the producers pay a certain amount per MWh according to the network voltage level in the feeding/delivery point.
<b>Emergency control action:</b>	Use of system tariffs. The consumers and the producers pay a certain amount per MWh according to the network voltage level in the feeding/delivery point.

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**On what basis do dispatchers select them?**

<b>Frequency control:</b>	The company who offers the primary control dispatch the instant capacity between the running production units on the basis of overall minimum dispatch costs.
<b>Spinning reserve:</b>	The company who offers the spinning reserve dispatch the capacity between the running production units on the basis of overall minimum dispatch costs.
<b>Standing reserve:</b>	The company who offers the standing reserve dispatch the standing reserve between the available production units on the basis of overall minimum dispatch costs, in accordance with the maintenance plan agreed with the System administrator.

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**Describe the incentives to ensure that future needs are met.**

There exist no incentives to ensure that future needs are met.

**Other System Support contracts?**

To avoid overloaded transmission lines due to transmission constraints the system operator can impose certain restrictions on the load dispatch of the power plants.

**What is the cost of ancillary services as a % of your total end-user price?**

There exist no account for that.

**How long has the current system of procuring and paying for ancillary services been used in your country?**

About two years.

**What problems have you experienced?**

None.

**Are there plans for major change regarding ancillary services in the future?**

No.

## FINLAND

### What are considered ancillary service in your country?

<b>Frequency control:</b>	Yes. Mainly hydro generators regulate the power real-time by frequency.
<b>Voltage control / reactive power:</b>	Yes. Mainly hydro generators regulate the voltage by adjusting reactive power. TSO has also reactors to control the voltage.
<b>Spinning reserve:</b>	Yes. Generators have spinning reserve.
<b>Standing reserve:</b>	Yes. TSO has a separate company that has gas turbines as a standing reserve.
<b>Black start capacity:</b>	No. Not commercial. Hydro companies have black start capacity.
<b>Remote automatic generation control:</b>	Yes. Balance and regulating power dealt in Nord Pool.
<b>Grid loss compensation:</b>	No. Not in use.
<b>Emergency control action:</b>	No.
<b>Other:</b>	No.

### Is it mandatory? On whom?

<b>Frequency control:</b>	No.
<b>Voltage control / reactive power:</b>	No.
<b>Spinning reserve:</b>	No.
<b>Standing reserve:</b>	No.
<b>Black start capacity:</b>	No.
<b>Remote automatic generation control:</b>	No.
<b>Grid loss compensation:</b>	No.
<b>Emergency control action:</b>	No.

### Who procures these ancillary services?

<b>Frequency control:</b>	TSO – Fingrid.
<b>Voltage control</b>	TSO – Fingrid.

<b>/ reactive power:</b>	
<b>Spinning reserve:</b>	TSO – Fingrid.
<b>Standing reserve:</b>	TSO – Fingrid.
<b>Remote automatic generation control:</b>	ISO.

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**Who provides these ancillary services?**

<b>Frequency control:</b>	Generators.
<b>Voltage control / reactive power:</b>	Generators, TSO.
<b>Spinning reserve:</b>	Generators.
<b>Standing reserve:</b>	Generators, TSO.
<b>Black start capacity:</b>	Generators.
<b>Remote automatic generation control:</b>	Generators.

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**What procurement / payment method is used?**

<b>Frequency control:</b>	Negotiated contracts.
<b>Voltage control / reactive power:</b>	Negotiated contracts.
<b>Spinning reserve:</b>	Negotiated contracts.
<b>Standing reserve:</b>	Negotiated contracts.
<b>Black start capacity:</b>	Negotiated contracts.
<b>Remote automatic generation control:</b>	Negotiated contracts.

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**How are charges for ancillary services determined?**

<b>Frequency control:</b>	Private contract, based on cost recovery.
<b>Voltage control / reactive power:</b>	Private contract, based on cost recovery.
<b>Spinning re-</b>	Private contract, based on cost recovery.

<b>serve:</b>	
<b>Standing reserve:</b>	Private contract, based on cost recovery.
<b>Black start capacity:</b>	Private contract, based on cost recovery.
<b>Remote automatic generation control:</b>	Private contract, based on cost recovery.

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**If Cost Recovery, what are the costs based on?**

<b>Frequency control:</b>	Lost revenue + Wear and Tear + Capital Costs.
<b>Voltage control / reactive power:</b>	Lost revenue + Wear and Tear + Capital Costs.
<b>Spinning reserve:</b>	Lost revenue + Wear and Tear + Capital Costs.
<b>Standing reserve:</b>	Lost revenue + Wear and Tear + Capital Costs.
<b>Black start capacity:</b>	Lost revenue + Wear and Tear + Capital Costs.
<b>Remote automatic generation control:</b>	Lost revenue + Wear and Tear + Capital Costs.

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**From whom are the costs recovered?**

<b>Frequency control:</b>	Customers.
<b>Voltage control / reactive power:</b>	Customers.
<b>Spinning reserve:</b>	Customers.
<b>Standing reserve:</b>	Customers.
<b>Black start capacity:</b>	Customers.
<b>Remote automatic generation control:</b>	Customers.

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**How are ancillary services costs recovered?**

<b>Frequency control:</b>	Use of System Tariffs.
<b>Voltage control / reactive power:</b>	Use of System Tariffs.
<b>Spinning reserve:</b>	Use of System Tariffs.

**On what basis do dispatchers select them?**

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**Frequency control:** Contract price.

**Voltage control / reactive power:** Contract price.

**Spinning reserve:** Contract price.

**Standing reserve:** Contract price.

**How long has the current system of procuring and paying for ancillary services been used in your country?**

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Since 1998.

**What problems have you experienced?**

The level of payments are quite low compared to actual costs for generators.

**Are there plans for major change regarding ancillary services in the future?**

No.

## HUNGARY

### What are considered ancillary service in your country?

<b>Frequency control:</b>	Yes. Single-buyer has long term power purchase agreements with Generators. These agreements contain technological parameters and the price of service. The single-buyer hands these parameters and price to Power operator. Power Operator controls the whole service of the system, and gives the quantities of service to the single-buyer. Single-buyer accounts with generators.
<b>Voltage control / reactive power:</b>	Yes. Single-buyer has long term power purchase agreements with Generators. These agreements contain technological parameters and the price of service. The single-buyer hands these parameters and price to Power operator. Power Operator controls the whole service of the system, and gives the quantities of service to the single-buyer. Single-buyer accounts with generators.
<b>Spinning reserve:</b>	Yes. Single-buyer has long term power purchase agreements with Generators. These agreements contain technological parameters and the price of service. The single-buyer hands these parameters and price to Power operator. Power Operator controls the whole service of the system, and gives the quantities of service to the single-buyer. Single-buyer accounts with generators.
<b>Standing reserve:</b>	Yes. Single-buyer has long term power purchase agreements with Generators. These agreements contain technological parameters and the price of service. The single-buyer hands these parameters and price to Power operator. Power Operator controls the whole service of the system, and gives the quantities of service to the single-buyer. Single-buyer accounts with generators.
<b>Black start capacity:</b>	Yes. Single-buyer has long term power purchase agreements with Generators. These agreements contain technological parameters of service. The single-buyer hands these parameters to Power operator. Power Operator controls the whole service of the system, and gives the quantities of service to the single-buyer. Single-buyer accounts with generators.
<b>Remote automatic generation control:</b>	Yes. Single-buyer has long term power purchase agreements with Generators. These agreements contain technological parameters and the price of service. The single-buyer hands these parameters and price to Power operator. Power Operator controls the whole service of the system, and gives the quantities of service to the single-buyer. Single-buyer accounts with generators.
<b>Grid loss compensation:</b>	No.
<b>Emergency control action:</b>	No. Government determine the priority list of demands. An emergency the Power System operator restricts or disconnect demands according with this priority list.
<b>Other:</b>	No.

### Is it mandatory? On whom?

<b>Frequency control:</b>	Yes. It is mandatory by government and private contract.
<b>Voltage control / reactive power:</b>	Yes. It is mandatory by government and private contract.
<b>Spinning reserve:</b>	Yes. It is mandatory by government and private contract.

<b>Standing reserve:</b>	Yes. It is mandatory by government and private contract.
<b>Black start capacity:</b>	Yes. It is mandatory by government and private contract.
<b>Remote automatic generation control:</b>	Yes. It is mandatory by government and private contract.
<b>Emergency control action:</b>	Yes. It is mandatory by government.

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**Who procures these ancillary services?**

<b>Frequency control:</b>	PSO.
<b>Voltage control / reactive power:</b>	PSO.
<b>Spinning reserve:</b>	PSO.
<b>Standing reserve:</b>	PSO.
<b>Black start capacity:</b>	PSO.
<b>Remote automatic generation control:</b>	PSO.
<b>Grid loss compensation:</b>	PSO.
<b>Emergency control action:</b>	PSO.

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**Who provides these ancillary services?**

<b>Frequency control:</b>	Generators.
<b>Voltage control / reactive power:</b>	Generators.
<b>Spinning reserve:</b>	Generators.
<b>Standing reserve:</b>	Generators.
<b>Black start capacity:</b>	Generators.
<b>Remote automatic generation control:</b>	Generators.
<b>Grid loss compensation:</b>	Generators.

<b>Emergency control action:</b>	Generators, demand.
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**What procurement / payment method is used?**

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<b>Frequency control:</b>	Negotiated contracts.
<b>Voltage control / reactive power:</b>	Negotiated contracts.
<b>Spinning reserve:</b>	Negotiated contracts.
<b>Standing reserve:</b>	Negotiated contracts.
<b>Black start capacity:</b>	Negotiated contracts.
<b>Remote automatic generation control:</b>	Negotiated contracts.
<b>Grid loss compensation:</b>	Negotiated contracts.
<b>Emergency control action:</b>	Negotiated contracts.

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**How are charges for ancillary services determined?**

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<b>Frequency control:</b>	Private Contract based on Cost Recovery.
<b>Voltage control / reactive power:</b>	Private Contract based on Cost Recovery.
<b>Spinning reserve:</b>	Private Contract based on Cost Recovery.
<b>Standing reserve:</b>	Private Contract based on Cost Recovery.
<b>Black start capacity:</b>	Set by Government based on fuel cost.
<b>Remote automatic generation control:</b>	Private Contract.
<b>Grid loss compensation:</b>	Private Contract.

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**If Cost Recovery, what are the costs based on?**

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<b>Frequency control:</b>	Lost Revenue.
<b>Voltage control / reactive power:</b>	Lost Revenue.
<b>Spinning reserve:</b>	Lost Revenue.

<b>Standing reserve:</b>	Capital Cost.
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**From whom are the costs recovered?**

<b>Frequency control:</b>	Customers.
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<b>Voltage control / reactive power:</b>	Customers.
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<b>Spinning reserve:</b>	Customers.
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<b>Standing reserve:</b>	Customers.
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**How are ancillary services costs recovered?**

<b>Frequency control:</b>	Single-buyer builds Ancillary Service cost in its all-in price and recovers this cost to the generators.
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<b>Voltage control / reactive power:</b>	Single-buyer builds Ancillary Service cost in its all-in price and recovers this cost to the generators.
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<b>Spinning reserve:</b>	Single-buyer builds Ancillary Service cost in its all-in price and recovers this cost to the generators.
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<b>Standing reserve:</b>	Single-buyer builds Ancillary Service cost in its all-in price and recovers this cost to the generators.
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<b>Black start capacity:</b>	Single-buyer builds Ancillary Service cost in its all-in price and recovers this cost to the generators.
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<b>Remote automatic generation control:</b>	Single-buyer builds Ancillary Service cost in its all-in price and recovers this cost to the generators.
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<b>Grid loss compensation:</b>	Single-buyer builds Ancillary Service cost in its all-in price and recovers this cost to the generators.
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**On what basis do dispatchers select them?**

<b>Frequency control:</b>	Contract price.
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<b>Voltage control / reactive power:</b>	Contract price.
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<b>Spinning reserve:</b>	Contract price.
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<b>Standing reserve:</b>	Contract price.
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<b>Black start capacity:</b>	Price.
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<b>Remote automatic generation control:</b>	Contract price.
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**Describe the incentives to ensure that future needs are met.**

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Every new power plant are required to be able to fulfil the UCTE's norms, so they have to perform the necessary Ancillary Service. In another way they don't get the licence for generation.

**Other System Support contracts?**

Rescheduling maintenance (Generator gets bonus if the generator reschedules programme of scheduled maintenance at the request for Power System Operator), Increased peak period capacity (Generator gets bonus if the generator operates greater capacity than its declared tested capacity at the request for Power System Operator during the peak period demand), Reduce off-peak period capacity (Generator gets bonus if the generator operates at a capacity which is less than the declared minimum capacity at the request for Power System Operator during the off-peak period demand).

**What is the cost of ancillary services as a % of your total end-user price?**

About 0,1% without standing reserve.

**How long has the current system of procuring and paying for ancillary services been used in your country?**

We have used this system for 6 years.

**What problems have you experienced?**

It is not enough incentive for generators, and consumers.

**Are there plans for major change regarding ancillary services in the future?**

We are going to make open electric market in Hungary, so we have to make a lot of change on our system. Our government is about to introduce the new electric law on this year. This law will contain the main ideas, but the details have to be worked out in the near future.

## IRELAND

### What are considered ancillary service in your country?

<b>Frequency control:</b>	Yes. Frequency Control is automatic via governor action and payment is included in spinning reserve payments.
<b>Voltage control / reactive power:</b>	Yes. Voltage Control / Reactive Power is an ancillary service which is centrally controlled by the independent TSO (Transmission System Operator).
<b>Spinning reserve:</b>	Yes. Spinning Reserve is an ancillary service, controlled by the TSO. This service is provided in different ways: Primary Op Reserve (5-15 sec) Secondary Reserve (15-90 sec) & Tertiary Reserve 1 (90s - 5 mins). This is typically provided by spinning machines, pumped storage and interruptible load demand.
<b>Standing reserve:</b>	Yes. Standing Reserve is an ancillary service controlled by the TSO. It is provided for in different ways: Tertiary Reserve 2 (5 mins - 20 mins) and Replacement Reserve (20 mins - 4 hrs.). This is typically provided by pumped storage and hydro turbines and open cycle GTs.
<b>Black start capacity:</b>	Yes. Black Start Capacity is an ancillary service controlled by the TSO. Certain designated units have contracts to provide this service.
<b>Remote automatic generation control:</b>	No. Not currently in use.
<b>Grid loss compensation:</b>	No.
<b>Emergency control action:</b>	No.
<b>Other:</b>	No.

### Is it mandatory? On whom?

<b>Frequency control:</b>	Yes. This is mandatory and automatically provided by all generators.
<b>Voltage control / reactive power:</b>	Yes. This is mandatory, provided by all generators.
<b>Spinning reserve:</b>	Yes. This is mandatory, provided by all generators.
<b>Standing reserve:</b>	Yes. This is mandatory, provided by all generators.
<b>Black start capacity:</b>	No. Certain generators have contracts with the TSO.

### Who procures these ancillary services?

<b>Frequency control:</b>	Rate is included in payment for spinning reserve.
<b>Voltage control / reactive power:</b>	TSO.
<b>Spinning reserve:</b>	TSO.

<b>Standing reserve:</b>	TSO.
<b>Black start capacity:</b>	TSO.

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**Who provides these ancillary services?**

<b>Frequency control:</b>	Generators.
<b>Voltage control / reactive power:</b>	This service is predominately provided by generators, with network devices providing some support also.
<b>Spinning reserve:</b>	Generators and interruptible customer load.
<b>Standing reserve:</b>	Generators.
<b>Black start capacity:</b>	Specific generators with contract with TSO.

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**What procurement / payment method is used?**

<b>Frequency control:</b>	Obligation / penalty.
<b>Voltage control / reactive power:</b>	Obligation / penalty. Rate is determined by TSO and approved by Regulator.
<b>Spinning reserve:</b>	Obligation / penalty. Rate is determined by TSO and approved by Regulator.
<b>Standing reserve:</b>	Obligation / penalty. Rate is determined by TSO and approved by Regulator.
<b>Black start capacity:</b>	Obligation / penalty. Rate is determined by TSO and approved by Regulator.

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**How are charges for ancillary services determined?**

<b>Frequency control:</b>	Rate included in Spinning Reserve rates.
<b>Voltage control / reactive power:</b>	Set by TSO and approved by Regulator.
<b>Spinning reserve:</b>	Set by TSO and approved by Regulator.
<b>Standing reserve:</b>	Set by TSO and approved by Regulator.
<b>Black start capacity:</b>	Set by TSO and approved by Regulator.

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**From whom are the costs recovered?**

<b>Voltage control / reactive power:</b>	Costs of all ancillary services are recovered by TSO from customers through Use of System levy on all supply companies.
<b>Spinning re-</b>	Costs of all ancillary services are recovered by TSO from customers through Use

<b>serve:</b>	of System levy on all supply companies.
<b>Standing reserve:</b>	Costs of all ancillary services are recovered by TSO from customers through Use of System levy on all supply companies.
<b>Black start capacity:</b>	Costs of all ancillary services are recovered by TSO from customers through Use of System levy on all supply companies.

#### **How are ancillary services costs recovered?**

<b>Frequency control:</b>	Costs of all ancillary services are recovered by TSO from customers through Use of System levy on all supply companies.
<b>Voltage control / reactive power:</b>	Costs of all ancillary services are recovered by TSO from customers through Use of System levy on all supply companies.
<b>Spinning reserve:</b>	Costs of all ancillary services are recovered by TSO from customers through Use of System levy on all supply companies.
<b>Standing reserve:</b>	Costs of all ancillary services are recovered by TSO from customers through Use of System levy on all supply companies.
<b>Black start capacity:</b>	Costs of all ancillary services are recovered by TSO from customers through Use of System levy on all supply companies.

#### **On what basis do dispatchers select them?**

<b>Voltage control / reactive power:</b>	TSO determines dispatch for all plants such that overall system costs are minimised. At times out-of-merit running is required for Voltage Control in certain locations and Spinning Reserve will then be optimised so that it is provided for at least overall cost.
<b>Spinning reserve:</b>	TSO determines dispatch for all plants such that overall system costs are minimised. At times out-of-merit running is required for Voltage Control in certain locations and Spinning Reserve will then be optimised so that it is provided for at least overall cost.
<b>Standing reserve:</b>	Next cheapest option which minimises the overall total cost of all ancillary services.
<b>Black start capacity:</b>	Black start is provided by hydro sets, pumped storage and open cycle gas turbines. The generators are selected on the basis of cheapest cost to provide the service and at dispersed locations so system recovery can be achieved in the shortest time.

#### **Describe the incentives to ensure that future needs are met.**

A generator will not be granted a licence unless the plant fully conforms with the grid code, so that both current and future needs can be met.

#### **Other System Support contracts?**

The concept of System Support contracts exists, but currently such contracts are not used in the market. The contract would be between the TSO and a generator or other party and can be used to allow the TSO purchase the required service at minimum cost, i.e. minimum overall cost to TSO, e.g. if a plant were no longer there the capital cost of providing transmission infrastructure could be greater than the cost of a system support contract with a generator to remain in the market. Again, the TSO will recover its costs by increasing the Use of System (equally) on all supply companies, so that in the end of the day the end customers pay.

#### **What is the cost of ancillary services as a % of your total end-user price?**

The cost of ancillary services is approximately 1% to 2% of the total end-user price.

#### **What problems have you experienced?**

The electricity market is in transition at the moment, going from a current partial market opening of ~30%, to full market opening in 2005.

**Are there plans for major change regarding ancillary services in the future?**

It is planned to change the payment structure for some ancillary services. For example, voltage support is currently 50% capability / 50% usage. The TSO has stated its intention to move towards 100% payment for usage in the future. It is not currently known, if this will happen or how quickly it would occur.

## NETHERLANDS

### What are considered ancillary service in your country?

<b>Frequency control:</b>	Yes.
<b>Voltage control / reactive power:</b>	Yes.
<b>Spinning reserve:</b>	Yes.
<b>Standing reserve:</b>	Yes.
<b>Black start capacity:</b>	Yes.
<b>Remote automatic generation control:</b>	Yes.
<b>Grid loss compensation:</b>	No.
<b>Emergency control action:</b>	Yes. AS, to be used when spinning, standing and AGC are exhausted.
<b>Other:</b>	No.

### Is it mandatory? On whom?

<b>Frequency control:</b>	Yes. > 5 MWe
<b>Voltage control / reactive power:</b>	No.
<b>Standing reserve:</b>	Yes. Obligation to offer free reserve to TSO
<b>Black start capacity:</b>	No.
<b>Remote automatic generation control:</b>	No.
<b>Grid loss compensation:</b>	No.
<b>Emergency control action:</b>	No.

### Who procures these ancillary services?

<b>Frequency control:</b>	TSO.
<b>Voltage control / reactive power:</b>	TSO, distributors.

<b>Spinning reserve:</b>	TSO.
<b>Standing reserve:</b>	TSO.
<b>Black start capacity:</b>	TSO.
<b>Remote automatic generation control:</b>	TSO by obligation of all generators to bid free reserves.
<b>Grid loss compensation:</b>	TSO.
<b>Emergency control action:</b>	TSO.

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**Who provides these ancillary services?**

<b>Frequency control:</b>	Generators.
<b>Voltage control / reactive power:</b>	Generators.
<b>Spinning reserve:</b>	Generators.
<b>Standing reserve:</b>	Generators, interruptible demand contracts.
<b>Black start capacity:</b>	Generators.
<b>Remote automatic generation control:</b>	Generators.
<b>Grid loss compensation:</b>	Generators; as well in as out of the Netherlands.
<b>Emergency control action:</b>	Generators.

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**What procurement / payment method is used?**

<b>Frequency control:</b>	Obligation without payment.
<b>Voltage control / reactive power:</b>	Negotiated contracts.
<b>Spinning reserve:</b>	Negotiated contracts.
<b>Standing reserve:</b>	Open market bidding.
<b>Black start capacity:</b>	Negotiated contracts.
<b>Remote auto-</b>	Negotiated contracts.

<b>automatic generation control:</b>	
<b>Grid loss compensation:</b>	Open market.
<b>Emergency control action:</b>	Negotiated contracts.

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**How are charges for ancillary services determined?**

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<b>Voltage control / reactive power:</b>	Regulated.
<b>Spinning reserve:</b>	Regulated kW-component; kWh-component according to spotmarket-price.
<b>Standing reserve:</b>	Regulated kW-component; kWh-component according to spotmarket-price.
<b>Black start capacity:</b>	Regulated.
<b>Remote automatic generation control:</b>	Regulated.
<b>Grid loss compensation:</b>	Regulated.
<b>Emergency control action:</b>	Regulated kW-component; kWh-component according to spotmarket-price.

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**If Cost Recovery, what are the costs based on?**

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<b>Voltage control / reactive power:</b>	By the bidder.
<b>Spinning reserve:</b>	By the bidder.
<b>Standing reserve:</b>	By the bidder.
<b>Black start capacity:</b>	By the bidder.
<b>Remote automatic generation control:</b>	By the bidder.
<b>Grid loss compensation:</b>	By the bidder.
<b>Emergency control action:</b>	By the bidder.

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**From whom are the costs recovered?**

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<b>Voltage control / reactive power:</b>	Generators and customers.
<b>Spinning reserve:</b>	Generators and customers.

<b>Standing reserve:</b>	Generators and customers.
<b>Black start capacity:</b>	Generators and customers.
<b>Remote automatic generation control:</b>	Generators and customers.
<b>Grid loss compensation:</b>	Generators and customers.
<b>Emergency control action</b>	Generators and customers.
<b>How are ancillary services costs recovered?</b>	
<b>Voltage control / reactive power:</b>	Uplift on transported kWhe.
<b>Spinning reserve:</b>	Uplift on transported kWhe and charges for kWhe for those who are in imbalance.
<b>Standing reserve:</b>	Uplift on transported kWhe and charges for kWhe for those who are in imbalance.
<b>Black start capacity:</b>	Uplift on transported kWhe.
<b>Remote automatic generation control:</b>	Uplift on transported kWhe and charges for kWhe for those who are in imbalance.
<b>Grid loss compensation:</b>	Uplift on transported kWhe.
<b>Emergency control action:</b>	Uplift on transported kWhe and charges for kWhe for those who are in imbalance.
<b>On what basis do dispatchers select them?</b>	
<b>Voltage control / reactive power:</b>	Minimum costs and local needs of the grid.
<b>Spinning reserve:</b>	Minimum costs, required ramp-up and system balance.
<b>Standing reserve</b>	Minimum costs, required ramp-up and system balance.
<b>Black start capacity:</b>	Local grid needs.
<b>Remote automatic generation control:</b>	Minimum costs, required ramp-up and system balance.
<b>Grid loss compensation:</b>	Minimum costs.
<b>Emergency</b>	System balance.

**control action** |

**Describe the incentives to ensure that future needs are met.**

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Three codes describe all requirements related to the system, the grid and the measurements.

**Other System Support contracts?**

The chosen system gives the TSO sufficient tools to operate the system.

**What is the cost of ancillary services as a % of your total end-user price?**

About 5 till 7% of the income of the producers.

**Are there plans for major change regarding ancillary services in the future?**

No.

**Any other comments on the effectiveness of your approach to Ancillary Services?**

To me it looks the system works well. But I have my doubts when demand exceeds available capacity. Creating market in a situation with overcapacity is nice, but when overcapacity is over???

## POLAND

### What are considered ancillary service in your country?

<b>Frequency control:</b>	there are two levels of frequency control: 1-primal control (local) 2- secondary control (centralised)
<b>Voltage control / reactive power:</b>	voltage control/control of reactive power takes place on the local level
<b>Spinning reserve:</b>	spinning reserve is not an ancillary service-there is possibility of using the spinning reserve within the frames of increase offers on the balancing market
<b>Standing reserve:</b>	the ancillary service of the standing reserve occurs in form of two different central services: 1-reconstructional reserve (start on the demand) 2- standing reserve (start up to 21 days)
<b>Black start capacity:</b>	occurs in two forms of services-capability to self-start and capability to operate in allocated systems
<b>Remote automatic generation control:</b>	there are nowadays two forms of Remote Automatic Generation Control (AGC): 1-automatic control of frequency and power from the central control unit (declining) as well as the generation control achieved by preparation of the production plans created on the basis of the of the sale contracts and the increase offers- it does not occur as the ancillary service but as the duty of the generating units which are centrally ordered
<b>Grid loss compensation:</b>	it does not occur as the ancillary service-the grid loss compensation is provided by the Transmission System Operator
<b>Emergency control action:</b>	it does not occur as the ancillary service but as a duty of generating units-suspension of the energy market and operating according to the orders of the National Power Dispatcher as well as the instructions of the emergency situation procedures
<b>Other:</b>	it occurs as the ancillary service -overload operation( above the unit output) and operation beneath the technical minimum of the unit

### Is it mandatory? On whom?

<b>Frequency control:</b>	it's mandatory for generating units of the output equal to and greater than 100MWe
<b>Voltage control / reactive power:</b>	it's mandatory for generating units of the output equal to or greater than 100MWe
<b>Spinning reserve:</b>	duty of providing the this service does not exist active units which participate in the balancing market define the amount
<b>Standing reserve:</b>	this service is voluntary,there is no such a duty to provide this service
<b>Black start capacity:</b>	this service is voluntary,there is no such a duty to provide this service
<b>Remote automatic generation control:</b>	it's mandatory for generating units of the output equal to and greater than 100MWe
<b>Emergency control action:</b>	it's mandatory for generating units of the output greater than 50MWe

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**Who procures these ancillary services?**

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<b>Frequency control:</b>	transmission system operator
<b>Voltage control / reactive power:</b>	transmission system operator
<b>Spinning reserve:</b>	within competence of transmission system operator
<b>Standing reserve:</b>	transmission system operator
<b>Black start capacity:</b>	transmission system operator
<b>Remote automatic generation control:</b>	within competence of transmission system operator
<b>Emergency control action:</b>	within competence of transmission system operator
<b>Other:</b>	transmission system operator

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**Who provides these ancillary services?**

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<b>Frequency control:</b>	generators
<b>Voltage control / reactive power:</b>	generators and the grid(system)
<b>Spinning reserve:</b>	generators
<b>Standing reserve:</b>	generators
<b>Black start capacity:</b>	generators
<b>Grid loss compensation:</b>	grid(system)
<b>Other</b>	generators

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**What procurement / payment method is used?**

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<b>Frequency control:</b>	negotiated contracts made on the basis of the offers
<b>Voltage control / reactive power:</b>	negotiated contracts made on the basis of the offers
<b>Standing reserve:</b>	negotiated contracts made on the basis of the offers
<b>Black start capacity:</b>	negotiated contracts made on the basis of the offers
<b>Other:</b>	negotiated contracts made on the basis of the offers

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**How are charges for ancillary services determined?**

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<b>Frequency control:</b>	tendered contracts made by transmission system operator with generators and costs recovery of transmission system operator
<b>Voltage control / reactive power:</b>	tendered contracts made by transmission system operator with generators and costs recovery of transmission system operator
<b>Standing reserve:</b>	tendered contracts for the reconstructional reserve and bilateral contracts for static reserve made by the transmission system operator nad the generators as well as the costs recovery of transmission system operator
<b>Other:</b>	tendered contracts made by transmission system operator with generators and costs recovery of transmission system operator

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**From whom are the costs recovered?**

<b>Frequency control:</b>	end buyers
<b>Voltage control / reactive power:</b>	end buyers
<b>Spinning reserve:</b>	end buyers
<b>Standing reserve:</b>	end buyers
<b>Black start capacity:</b>	end buyers
<b>Remote automatic generation control:</b>	end buyers
<b>Grid loss compensation:</b>	end buyers
<b>Emergency control action:</b>	end buyers
<b>Other:</b>	end buyers

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**How are ancillary services costs recovered?**

<b>Frequency control:</b>	transmission system operator tariff
<b>Voltage control / reactive power:</b>	transmission system operator tariff
<b>Spinning reserve:</b>	transmission system operator tariff
<b>Standing reserve:</b>	transmission system operator tariff
<b>Black start capacity:</b>	transmission system operator tariff
<b>Remote automatic generation control:</b>	transmission system operator tariff

<b>Grid loss compensation:</b>	transmission system operator tariff
<b>Emergency control action:</b>	transmission system operator tariff
<b>Other:</b>	transmission system operator tariff

**On what basis do dispatchers select them?**

<b>Frequency control:</b>	contract price- during the stage of the services selection and negotiations with service providers
<b>Voltage control / reactive power:</b>	contract price- during the stage of the services selection and negotiations with service providers
<b>Standing reserve:</b>	contract price- during the stage of the services selection and negotiations with service providers
<b>Black start capacity:</b>	contract price- during the stage of the services selection and negotiations with service providers
<b>Other:</b>	contract price- during the stage of the services selection and negotiations with service providers

**How long has the current system of procuring and paying for ancillary services been used in your country?**

since the 1st of July 2001

## PORTUGAL

### What are considered ancillary service in your country?

<b>Frequency control:</b>	Yes, Description: Maintaining the frequency by continuous modulation of active power by TSO. Frequency control is guaranteed by the "Automatic Frequency Control" with automatic response of units, fixed at +/- 5%. Other conditions of frequency control are guaranteed by the local units adjustments, like: Frequency Alarme 47.5Hz; Frequency Illotage after 3sec at 47.5Hz and Automatic Unit Outage after 10sec at 47.5Hz.
<b>Voltage control / reactive power:</b>	Yes Description: Maintaining voltage through injecting or absorbing reactive power by synchronous or static compensation. Automatic Voltage Control of units is fixed at +/- 5%, it's a local control, but is supervised and centralised by the TSO. Some generators can provide the service of Synchronous motor
<b>Spinning reserve:</b>	Doesn't apply as Ancillary Service
<b>Standing reserve:</b>	Yes. Description: We have two figures of Standing Reserve, Cold and Hot, which means: Hot - unit start according to hot start conditions; Cold - unit start according to cold start conditions
<b>Black start capacity:</b>	Doesn't apply
<b>Remote automatic generation control:</b>	Yes, Description: Regulating the output load of the unit through a central-control system. Some units have Remote Automatic Generation and it is available between steps of load.
<b>Grid loss compensation:</b>	Doesn't apply
<b>Emergency control action:</b>	Doesn't apply
<b>Other:</b>	Yes, Description: Some generators provide the service of Synchronous motor

### Is it mandatory? On whom?

<b>Frequency control:</b>	Yes, Operator
<b>Voltage control / reactive power:</b>	Yes, Operator
<b>Spinning reserve:</b>	Doesn't apply
<b>Standing reserve:</b>	Yes, Operator
<b>Black start capacity:</b>	Doesn't apply
<b>Remote automatic generation control:</b>	Yes, Operator if the unit is equipped with this device
<b>Grid loss compensation:</b>	Doesn't apply
<b>Emergency</b>	Doesn't apply

control action: |

**Who procures these ancillary services?**

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<b>Frequency control:</b>	Transmission System
<b>Voltage control / reactive power:</b>	Transmission System
<b>Spinning reserve:</b>	Doesn't apply
<b>Standing reserve:</b>	Transmission System
<b>Black start capacity:</b>	Doesn't apply
<b>Remote automatic generation control:</b>	Transmission System
<b>Grid loss compensation:</b>	Doesn't apply
<b>Emergency control action:</b>	Doesn't apply
<b>Other:</b>	

**Who provides these ancillary services?**

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<b>Frequency control:</b>	Generators
<b>Voltage control / reactive power:</b>	Generators; Network Devices
<b>Spinning reserve:</b>	Doesn't apply
<b>Standing reserve:</b>	Generators
<b>Black start capacity:</b>	Doesn't apply
<b>Remote automatic generation control:</b>	Generators
<b>Grid loss compensation:</b>	Doesn't apply
<b>Emergency control action:</b>	Doesn't apply
<b>Other</b>	

**What procurement / payment method is used?**

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<b>Frequency control:</b>	Obligation
<b>Voltage control</b>	Obligation. Negotiate Contracts

<b>/ reactive power:</b>	
<b>Spinning reserve:</b>	Doesn't apply
<b>Standing reserve:</b>	Obligation. Negotiate Contracts
<b>Black start capacity:</b>	Doesn't apply
<b>Remote automatic generation control:</b>	Generators
<b>Grid loss compensation:</b>	Doesn't apply
<b>Emergency control action:</b>	Doesn't apply
<b>Other:</b>	

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**How are charges for ancillary services determined?**

<b>Frequency control:</b>	Doesn't apply
<b>Voltage control / reactive power:</b>	Based in number of hours and hourly cost
<b>Spinning reserve:</b>	Doesn't apply
<b>Standing reserve:</b>	Based in number of hours and hourly cost
<b>Black start capacity:</b>	Doesn't apply
<b>Remote automatic generation control:</b>	Based in number of kWh and AGC cost
<b>Grid loss compensation:</b>	Doesn't apply
<b>Emergency control action:</b>	Doesn't apply

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**If cost recovery, what are the costs based on?**

<b>Frequency control:</b>	Doesn't apply
<b>Voltage control / reactive power:</b>	Doesn't apply
<b>Spinning reserve:</b>	Doesn't apply
<b>Standing reserve:</b>	Doesn't apply

<b>Black start capacity:</b>	Doesn't apply
<b>Remote automatic generation control:</b>	Doesn't apply
<b>Grid loss compensation:</b>	Doesn't apply
<b>Emergency control action:</b>	Doesn't apply

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**From whom are the costs recovered?**

<b>Frequency control:</b>	Doesn't apply
<b>Voltage control / reactive power:</b>	Doesn't apply
<b>Spinning reserve:</b>	Doesn't apply
<b>Standing reserve:</b>	Doesn't apply
<b>Black start capacity:</b>	Doesn't apply
<b>Remote automatic generation control:</b>	Doesn't apply
<b>Grid loss compensation:</b>	Doesn't apply
<b>Emergency control action:</b>	Doesn't apply
<b>Other:</b>	

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**How are ancillary services costs recovered?**

<b>Frequency control:</b>	Doesn't apply
<b>Voltage control / reactive power:</b>	System tariffs
<b>Spinning reserve:</b>	Doesn't apply
<b>Standing reserve:</b>	System tariffs
<b>Black start capacity:</b>	Doesn't apply
<b>Remote automatic generation control:</b>	System tariffs
<b>Grid loss compensation:</b>	Doesn't apply

<b>Emergency control action:</b>	Doesn't apply
<b>Other:</b>	

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**On what basis do dispatchers select them?**

<b>Frequency control:</b>	Doesn't apply
<b>Voltage control / reactive power:</b>	Technical considerations
<b>Spinning reserve:</b>	Doesn't apply
<b>Standing reserve:</b>	Technical considerations
<b>Black start capacity:</b>	Doesn't apply
<b>Remote automatic generation control:</b>	Technical considerations
<b>Grid loss compensation:</b>	Doesn't apply
<b>Emergency control action:</b>	Doesn't apply
<b>Other:</b>	

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**Describe the incentives to ensure that future needs are met**

Doesn't apply

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**Do you have other system support contracts?**

No

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**What is the cost of ancillary services as a % of your total end-user price?**

About 0.5%

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**How long has the current system of procuring and paying for ancillary services been used in your country?**

Since 1994

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**What problems have you experienced?**

No problems experienced

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**Are there are plans for major change regarding ancillary services in the future?**

No, there aren't

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**Any other comments on the effectiveness of your approach to Ancillary Services?**

## SPAIN

### What are considered ancillary service in your country?

<b>Frequency control:</b>	Yes. This is called primary regulation: automatic increase or decrease of power as a response to network frequency alterations. Definition of the service: 1.5 % of rated power in less than 15s for disturbances larger than 100 mHz and between 15s and 30s for cases in between 100 mHz to 200 mHz. The maximum deadband allowed is 10 mHz.
<b>Voltage control / reactive power:</b>	No.
<b>Spinning reserve:</b>	Yes. This ancillary service is called tertiary reserve and includes both spinning and non-spinning. The requirement for the units providing this service is to achieve the output within the next 15 minutes to the time they are called.
<b>Standing reserve:</b>	Yes. This ancillary service is called tertiary reserve and includes both spinning and non-spinning. The requirement for the units providing this service is to achieve the output within the next 15 minutes to the time they are called.
<b>Black start capacity:</b>	No. Still on the drawing board.
<b>Remote automatic generation control:</b>	Yes. This is the only competitive capacity market developed so far. The service is provided by a portfolio of units called regulation zone. A regulation zone is a set of generating units under a single AGC. The control is automatic and presents a hierarchical structure: SO sends signals to each company central dispatch and it sends signals to its own units.
<b>Grid loss compensation:</b>	No.
<b>Emergency control action:</b>	No.
<b>Other:</b>	Yes. The Deviations-management market is a rescheduling process intended to fix large differences between generation and consumption for the range of hours that are not going to be renegotiated in an intra-day market. Constraint management and Unbalancing 1/4h base.

### Is it mandatory? On whom?

<b>Frequency control:</b>	Yes. Mandatory (no remuneration considered) service that must be installed at every generating unit. Generating units that don't comply may contract the service.
<b>Voltage control / reactive power:</b>	Yes. Partially obligatory.
<b>Spinning reserve:</b>	No.
<b>Standing reserve:</b>	No.
<b>Black start capacity:</b>	No.
<b>Remote auto-</b>	No.

**matic generation control:**  
**Grid loss compensation:**  
**Emergency control action:**  
**Deviation management:**

No.  
 No.  
 No.

**Who procures these ancillary services?**

**Frequency control:**  
**Voltage control / reactive power:**  
**Spinning reserve:**  
**Black start capacity:**  
**Remote automatic generation control:**  
**Deviation management:**

System Operator.  
 ISO.  
 ISO.  
 TSO.  
 ISO. After the viable schedule is known, the system operator publishes the hourly up and down secondary reserve needs. This figure is known to the generation companies before submitting any bids.  
 ISO.

**Who provides these ancillary services?**

**Frequency control:**  
**Voltage control / reactive power:**  
**Spinning reserve:**  
**Remote automatic generation control:**  
**Deviation management:**

Generators.  
 Generators, demands and network devices.  
 Generators.  
 Generators.  
 Generators.

**What procurement / payment method is used?**

**Frequency control:**  
**Voltage control / reactive power:**  
**Spinning reserve:**

No remuneration.  
 Partially obligatory and partially subject to payment based on performance.  
 A real time market is implemented. Generators submit bids to increase or decrease their output. The most expensive (resp. cheapest) accepted bid within each hour set the marginal price at which all the accepted bids are paid (resp. pay) for the increase (resp. decrease) of their outputs.

<b>Remote automatic generation control:</b>	Open market bidding.
<b>Deviation management:</b>	Open market bidding.

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**How are charges for ancillary services determined?**

<b>Voltage control / reactive power:</b>	Regulated.
<b>Spinning reserve:</b>	Spot market.
<b>Remote automatic generation control:</b>	Spot market.
<b>Deviation management:</b>	Spot market.

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**How are ancillary services costs recovered?**

<b>Voltage control / reactive power:</b>	Uplift.
<b>Spinning reserve:</b>	Agents pay the extra costs of AA.SS proportional to their use (deviations). Non eligible customers share those costs in proportion to their consumption.
<b>Remote automatic generation control:</b>	Uplift.
<b>Deviation management:</b>	Agents pay the extra costs of AA.SS proportional to their use (deviations). Non eligible customers share those costs in proportion to their consumption.

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**On what basis do dispatchers select them?**

<b>Voltage control / reactive power:</b>	System requirements in real time.
<b>Spinning reserve:</b>	Merit order based on cheapest hourly bids.
<b>Remote automatic generation control:</b>	Merit order based on cheapest hourly bids.
<b>Deviation management:</b>	Merit order based on cheapest hourly bids.

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**Describe the incentives to ensure that future needs are met**

A capacity payment is considered. Units that are available and have run a minimum of 480 hours at maximum load receive this payment.

**Other System Support contracts?**

The fixing of the network constraints are run by the Market and System Operators considering both technical and economic issues in an hourly base.

**What is the cost of ancillary services as a % of your total end-user price?**

The cost of Ancillary Services (year 2000) = 6,47% of total End-Iberdrola price.

**How long has the current system of procuring and paying for ancillary services been used in your country?**

Since January 1, 1998.

**What problems have you experienced?**

Tertiary regulation bids must have a ramp time less than 15 minutes and be maintainable for two hours. There is no special mechanism to check these characteristics. Rules to calculate the amount of tertiary reserve that must be dispatched at any point in time must be developed.

Regulating energy is paid by those who deviate and proportionally to the absolute value of the deviation. The price depends on the whole of the deviations of all participants. No final wholesale price of electricity.

For voltage control /reactive power, the design presents a non-competitive service based on payment of a measured service subject to non-following considerations and rated at an approved tariff. Debugging the measurement procedures will be necessary. The time-of-delivery issue in reality differentiates the quality of service. This characteristic will eventually be considered.

## SWEDEN

### What are considered ancillary service in your country?

<b>Frequency control:</b>	Yes.
<b>Voltage control / reactive power:</b>	Yes.
<b>Spinning reserve:</b>	Yes.
<b>Standing reserve:</b>	Yes.
<b>Black start capacity:</b>	Yes.
<b>Remote automatic generation control:</b>	No.
<b>Grid loss compensation:</b>	No.
<b>Emergency control action:</b>	No.
<b>Other:</b>	No.

### Is it mandatory? On whom?

<b>Frequency control:</b>	Yes. TSO.
<b>Voltage control / reactive power:</b>	Yes. TSO.
<b>Spinning reserve:</b>	Yes. TSO.
<b>Standing reserve:</b>	Yes. TSO.
<b>Black start capacity:</b>	Yes. TSO.
<b>Remote automatic generation control:</b>	No.
<b>Grid loss compensation:</b>	No.
<b>Emergency control action:</b>	No.

### Who procures these ancillary services?

<b>Frequency control:</b>	TSO.
<b>Voltage control</b>	TSO.

/ reactive power:	
Spinning reserve:	TSO.
Standing reserve:	TSO.
Black start capacity:	TSO.

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**Who provides these ancillary services?**

Frequency control:	Generators.
Voltage control / reactive power:	TSO.
Spinning reserve:	Generators.
Standing reserve:	Generators.
Black start capacity:	Generators.
Grid loss compensation:	Open market.

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**What procurement / payment method is used?**

Frequency control:	Negotiated contracts.
Voltage control / reactive power:	Obligation, no payment.
Spinning reserve:	Negotiated contracts.
Standing reserve:	Negotiated contracts.
Black start capacity:	Obligation, no payment.
Grid loss compensation:	Contracts.

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**How are charges for ancillary services determined?**

Frequency control:	Open market.
Spinning reserve:	Open market.
Standing reserve:	Open market.
Grid loss compensation:	Open market.

**If Cost Recovery, what are the costs based on?**

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<b>Frequency control:</b>	By the bidder.
<b>Spinning reserve:</b>	By the bidder.
<b>Standing reserve:</b>	By the bidder.
<b>Grid loss compensation:</b>	Open market.

**From whom are the costs recovered?**

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<b>Frequency control:</b>	TSO recovers from market actors.
<b>Spinning reserve:</b>	TSO recovers from market actors.
<b>Standing reserve:</b>	TSO recovers from market actors.
<b>Grid loss compensation:</b>	Generators and customers.

**How are ancillary services costs recovered?**

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<b>Frequency control:</b>	System Tariffs.
<b>Spinning reserve:</b>	System Tariffs.
<b>Standing reserve:</b>	Recovered from system imbalance costs, recovered from suppliers and generators.
<b>Grid loss compensation:</b>	Tariff.

**On what basis do dispatchers select them?**

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<b>Frequency control:</b>	Minimum dispatch cost.
<b>Spinning reserve:</b>	Minimum dispatch cost.
<b>Standing reserve:</b>	Minimum dispatch cost.
<b>Grid loss compensation:</b>	Minimum dispatch cost.

## UNITED KINGDOM

### What are considered ancillary service in your country?

<b>Frequency control:</b>	Yes
<b>Centrally Controlled:</b>	<p>Frequency Control by means of Frequency sensitive generation - Each Generating Unit must be capable of contributing to Frequency and voltage control by continuous modulation of Active Power and Reactive Power. Each Generating Unit must be fitted with a fast acting proportional turbine speed governor and unit load controller or equivalent control device to provide Frequency response under normal operational conditions. NGC may issue an instruction to a Genset to operate so as to provide Primary Response and/or Secondary Response and/or High Frequency Response in the combinations agreed in the relevant Ancillary Services Agreement.</p> <p>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.</p> <p>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.</p> <p>High 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.</p> <p>Frequency Control by means of Fast Start - Agreements may be set-up between NGC and a Generator for Fast Start capability. Such Gensets may be used for Operating Reserve by NGC and their Start-Up may be initiated by Frequency-level relays with settings in the range 49Hz to 50Hz</p>
<b>Voltage control / reactive power:</b>	Yes. Reactive Power supplied otherwise than by means of synchronous or static compensators. All Generating Units must be capable of supplying rated power output (MW) at any point between the limits 0.85 power factor lagging and 0.95 power factor leading at the Generating Unit terminals. The short circuit ratio of Generat-

	<p>ing Units shall be not less than 0.5. Ancillary Service instructions in relation to Reactive Power may include:</p> <ul style="list-style-type: none"> <li>(i) MVAR Output</li> <li>(ii) Target Voltage Levels</li> <li>(iii) Tap Changes</li> <li>(iv) Maximum MVAR Output ('maximum excitation')</li> <li>(v) Maximum MVAR Absorption ('minimum excitation')</li> </ul>
<b>Spinning reserve:</b>	No
<b>Standing reserve:</b>	<p>Yes. At certain times of the day NGC needs extra power in the form of either generation or demand reduction to be able to deal with actual demand being greater than forecast demand and plant breakdowns. This requirement is met from synchronised and non-synchronised sources. NGC procures the non-synchronised requirement by contracting for Standing Reserve, provided by a range of service providers including generating units, demand reduction and independent generating plant.</p> <p>The need for Standing Reserve varies across the year, the time of week and time of day, being a function of the system demand profile at that time. To reflect this, NGC splits the year into five Seasons, for both Working Days (including Saturdays) and Non-Working Days (Sundays and most Bank Holidays), and specifies the periods in each day that Standing Reserve is required. These periods are referred to as Availability Windows.</p> <p>To be useful to NGC, a Standing Reserve provider must be able to :</p> <ul style="list-style-type: none"> <li>➤ offer a minimum of 3MW or more of generation or steady demand reduction (this can be from a number of sites as long as NGC sees a minimum aggregate of 3MW);</li> <li>➤ offer a Response Time from instruction by NGC to actual generation or demand reduction of 20 minutes or less;</li> <li>➤ provide Reserve for at least 2 hours when instructed;</li> <li>➤ have a Recovery Period after provision of Reserve of not more than 1200 minutes (20 hours); and</li> </ul> <p>provide Standing Reserve at least 3 times a week</p>
<b>Black start capacity:</b>	<p>Yes. Black Start Capability - It is an essential requirement that the NGC Transmission System must incorporate a Black Start Capability. This will be achieved by agreeing a Black Start Capability at a number of strategically located Power Stations.</p>
<b>Remote automatic generation control:</b>	No
<b>Grid loss compensation:</b>	No
<b>Emergency control action:</b>	No
<b>Other:</b>	<p>Yes. Warming and Hot Standby + Fast Reserve</p> <p>Warming Service - An adequate Operating Margin is required at the day-ahead time-scales, as contingent generation reserves in excess of forecast demand, to ensure that the system security can be properly managed. This means that some marginal generation, will need to be prepared for possible operation. NGC will</p>

offer 'warming' contractual arrangements to Generators to facilitate their willingness to provide 'energy readiness' capabilities that can be converted into timely energy utilisations, synchronised reserves or frequency response services. Under NETA (New Electricity Trading Arrangement), the 'Warming' service is the ability of a generating unit to deliver an Offer in the Balancing Mechanism. The decision to instruct the service of 'Warming' will be at the discretion of NGC, but in any case will be based on system requirements, anticipated price and behaviour in the BM, reliability, plant dynamics and physical location of plant.

Hot Standby Service - It may be necessary to hold some generation in a 'state of readiness' to generate at short notice. Under these circumstances, fuel will be used or energy taken to maintain this state of readiness. NGC will offer 'hot standby' contractual terms to Generators to facilitate their 'energy readiness' capabilities so that can be converted into timely energy utilisations, synchronised reserves or frequency response services. Under NETA, the 'Hot Standby' service is the ability of a generating unit to sustain the readiness capability to deliver an Offer in the Balancing Mechanism, following the provision of 'Warming.' The decision to instruct the service of 'Hot Standby' will be at the discretion of NGC, but in any case will be based on system requirements, anticipated price and behaviour in the BM, reliability, plant dynamics and physical location of plant.

Fast Reserve is the rapid and reliable delivery of active power provided as an increased output from generation or a reduction in consumption from demand sources, following receipt of an electronic despatch instruction from National Grid. Active power delivery must start within 2 minutes of the despatch instruction at a delivery rate in excess of 25MW/minute, and the reserve energy should be sustainable for a minimum of 15 minutes.

**Is it mandatory? On whom?**

<b>Frequency control:</b>	Yes. Generators
<b>Voltage control / reactive power:</b>	Yes. Generators
<b>Standing reserve:</b>	No
<b>Black start capacity:</b>	Yes, if strategically required by TSO. Generators
<b>Warming and hot stand-by; Fast reserve:</b>	No

**Who procures these ancillary services?**

<b>Frequency control:</b>	TSO
<b>Voltage control / reactive power:</b>	TSO
<b>Standing reserve:</b>	TSO
<b>Black start capacity:</b>	TSO
<b>Warming and</b>	TSO

**hot stand-by;  
Fast reserve:**

**Who provides these ancillary services?**

<b>Frequency control:</b>	Generators
<b>Voltage control / reactive power:</b>	Generators
<b>Standing reserve:</b>	Generators, large customers
<b>Black start capacity:</b>	Generators
<b>Warming and hot stand-by; Fast reserve:</b>	Generators

**What procurement / payment method is used?**

<b>Frequency control:</b>	The occasional frequency control requirements can be managed by either changing generating unit outputs or by changing demand. Generators can provide both the mandatory and commercial services. Large electricity consumers who are prepared to interrupt their demand automatically for short periods can also provide these occasional frequency services.
<b>Voltage control / reactive power:</b>	Default payment scheme or option to negotiate contract
<b>Standing reserve:</b>	Tendered Bidding Process
<b>Black start capacity:</b>	Standing Reserve is currently contracted annually via a competitive tender process, notification is given via the NGC web site and published in the Financial Times.
<b>Warming and hot stand-by; Fast reserve:</b>	Negotiated

**How are charges for ancillary services determined?**

<b>Frequency control:</b>	Cost Recovery
<b>Voltage control / reactive power:</b>	Default or Tendered Contract
<b>Standing reserve:</b>	Tendered Contract
<b>Black start capacity:</b>	Cost Recovery
<b>Warming and hot stand-by; Fast reserve:</b>	Tendered Contract

**If Cost Recovery, what are the costs based on?**

<b>Frequency control:</b>	Wear and Tear, Lost Revenue (including loss of efficiency)
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<b>Black start capacity:</b>	Wear and Tear, Investment recovery and routine operating & maintenance cost (including tax on asset)
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**From whom are the costs recovered?**

<b>Frequency control:</b>	Everyone who imports MWh from, or exports MWh to, the electricity market
<b>Voltage control / reactive power:</b>	Everyone who imports MWh from, or exports MWh to, the electricity market
<b>Standing reserve:</b>	Everyone who imports MWh from, or exports MWh to, the electricity market
<b>Black start capacity:</b>	Everyone who imports MWh from, or exports MWh to, the electricity market
<b>Warming and hot stand-by; Fast reserve:</b>	Everyone who imports MWh from, or exports MWh to, the electricity market

**How are ancillary services costs recovered?**

<b>Frequency control:</b>	Balancing Services Use of System Charges
<b>Voltage control / reactive power:</b>	Balancing Services Use of System Charges
<b>Standing reserve:</b>	Recovered from system imbalance costs recovered from Suppliers and Generators
<b>Black start capacity:</b>	Balancing Services Use of System Charges
<b>Warming and hot stand-by; Fast reserve:</b>	Recovered from system imbalance costs recovered from Suppliers and Generators

**On what basis do dispatchers select them?**

<b>Frequency control:</b>	Overall minimum dispatch cost including technical dynamics
<b>Voltage control / reactive power:</b>	Overall minimum dispatch cost including technical dynamics
<b>Standing reserve:</b>	Overall minimum dispatch cost including technical dynamics
<b>Black start capacity:</b>	Overall minimum dispatch cost including technical dynamics

**Describe the incentives to ensure that future needs are met**

License Obligations on Transmission System Operator and License/Grid Code obligations on Generators/Suppliers

**Other System Support contracts?**

No

**How long has the current system of procuring and paying for ancillary services been used in your country?**

The foundations have been in place since 1989 but changes have recently been made following the introduction of The New Electricity Trading Arrangements 27th March 2001

**What problems have you experienced?**

Although the types of ancillary services currently provided have existed for some time the various mechanisms used to calculate income from these had changed on the introduction of The New Electricity Trading Arrangements on 27th March 2001. The new arrangements are penal when generators or suppliers cause energy imbalances on the transmission system. However, providing frequency response (probably the most significant of the ancillary services provided) causes the provider to be 'out of balance' i.e. not properly predict their supply to or offtake from the transmission system. This issue was resolved in early 2003 by quantifying the frequency response energy volume and treating it accordingly.

**Are there plans for major change regarding ancillary services in the future?**

No, they have just been reviewed as part of the New Electricity Trading Arrangements. Continual review does take place.

**Any other comments on the effectiveness of your approach to Ancillary Services?**

No.



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