Overview of ancillary services

Authors: Martin Beck, Marc Scherer

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1 Ancillary services

swissgrid is responsible for the secure, reliable operation of the Swiss transmission system and for connections to the transmission systems of foreign operators. To this end swissgrid coordinates operation of the systems with neighbouring transmission system operators and supervises the Swiss control area, for which purpose swissgrid needs ancillary services.
System services in the electricity supply area are defined as services essential for the functioning of the system. Such services are delivered by grid operators to customers in addition to the transmission and distribution of electricity and hence determine the quality of the electricity supply. Ancillary services include:

- (Active power) control reserve
  - Primary control
  - Secondary control
  - Tertiary control
- Voltage support
- Compensation of active power losses
- Black start and island operation capability
- System coordination
- Operational measurement

In accordance with Article 22 of the Electricity Supply Ordinance, from 1 January 2009 swissgrid is required to purchase system services in accordance with a transparent, non-discriminatory and market-based procedure. It does this in accordance with the technical specifications of the European Network of Transmission System Operators for Electricity ENTSO-E (UCTE[1]).

The details of ancillary service provision are being drawn up by swissgrid. The contract scenario envisages signing a framework agreement with service providers following a technical and operational appraisal (prequalification) of providers and their power stations. On this basis, providers are then eligible to bid for the ancillary service in question.

The following overview describes the individual ancillary services and summarises the intended procurement processes and procedures.

2 (Active power) control reserve

Electrical energy (electricity) cannot be stored in large quantities by conventional means. For this reason, at any given point in time, the amount of electricity produced must correspond precisely to the amount being used. This balance guarantees the secure operation of the electricity grid at a constant frequency of 50 Hz (Hertz). Unforeseen fluctuations between the feed-in and/or feed-out of electrical energy in the network must be balanced out at short notice by rapidly increasing or reducing the power plant output of the suppliers of the so-called control reserve[2].

Reserve energy is required if, in the current capacity balance of a control area, the sum of the actual feed-in and withdrawal deviates from the sum of the expected capacities. This deviation can originate on the network load side – for instance as a result of meteorological influences, natural inaccuracy in the load forecast – and on the production side – for example due to production restrictions or stoppages, additional output from hydroelectric power plants due to heavy precipitation. Each transmission system operator must therefore continually use control power to offset balance capacity variations in its control area.

[1] UCTE, which until July 1999 was known as UCPTE (Union pour la coordination de la production et du transport de l'électricité), was incorporated into ENTSO-E on 1 July 2009 and continues to exist as «Regional Group Continental Europe».

[2] This is referred to as frequency power control or (active power) grid control.

Technically this is achieved within the synchronous electricity grid of the UCTE in Europe by a three-stage regulation procedure (primary, secondary, and tertiary control). The following example is of a power station failure in France. In the entire UCTE region, primary control is activated directly. After 30 seconds, secondary control power is automatically called up in France, and replaced after 15 minutes by tertiary control, in this example provided by power stations in France and Spain.

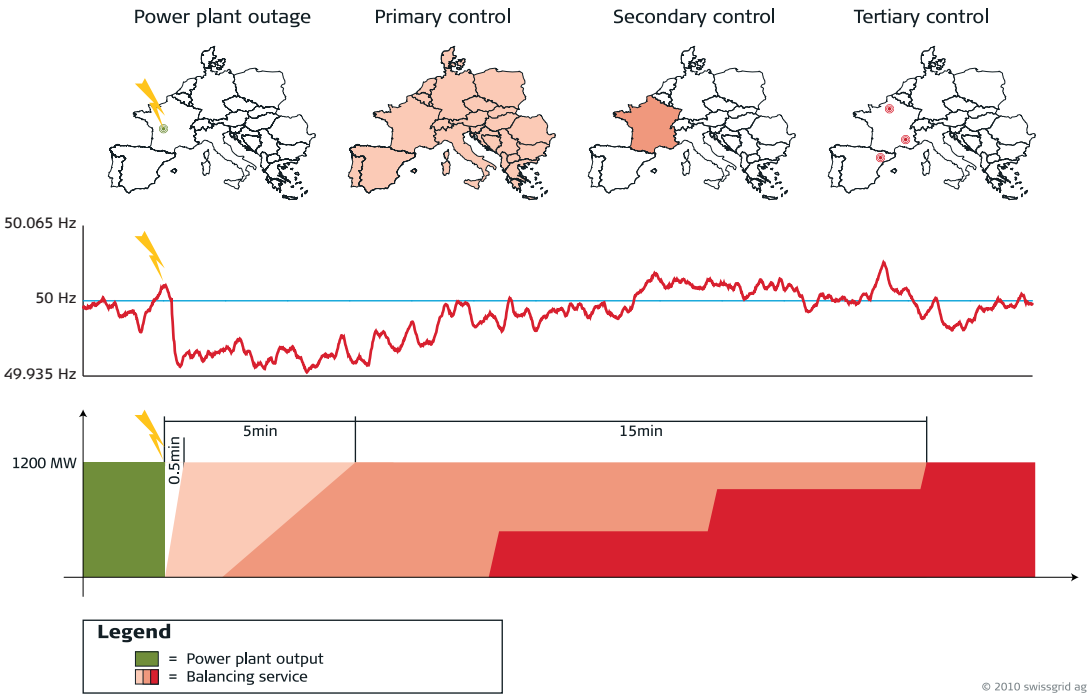

Figure 1: Example of a power plant outage in France

2.1 Primary control

Primary control restores the balance between power generation and consumption within seconds of the deviation occurring. During this operation, the frequency is stabilised within the permissible limit values. Activation takes place directly in the power stations by means of turbine regulators. In this phase, the network frequency is monitored and, in the event of deviations, the primary control power needed is activated. All transmission system operators represented in the UCTE must fulfil the requirements in their country in accordance with the UCTE rules: the primary control power capacity which must be kept in reserve at any time is adjusted annually in November in accordance with ENTSO-E requirements (in Switzerland this is always approximately 70 MW with a frequency deviation of ±200 MHz).

Product-specific information can be found in the document «Principles of ancillary services products» [1].

2.2 Secondary control

Secondary control is used to maintain the desired energy exchange of a control area with the rest of the UCTE grid, with simultaneous, integral support to maintain the frequency at 50 Hz. In the event of an imbalance between production and consumption, secondary control power in the connected power stations is automatically actuated by the central grid controller. As a condition these power stations must be in operation but not generating the maximum or minimum possible nominal capacity, in order to meet the requirements of the central load frequency controller at all times. Secondary control is activated after a few seconds and is typically completed after 15 minutes. If the cause of the control deviation is not eliminated after 15 minutes, secondary control gives way to tertiary control.

Product-specific information can be found in the document «Principles of ancillary services products» [1].

2.3 Tertiary control

Tertiary control is used for the relief of the secondary control reserve in order to restore a sufficient secondary control volume. The tertiary control reserve is above all necessary for adjusting major, persistent control deviations, in particular after production outages or unexpectedly long-lasting load changes. Activation is effected by the swissgrid dispatcher by means of special electronically transmitted messages to the providers, who must then intervene in power plant production to ensure the supply of tertiary control power within 15 minutes, irrespective of the schedule matrix.

Product-specific information can be found in the document «Principles of ancillary services products» [1].

3 Voltage support

The voltage at a node can be affected by the exchange of reactive power. The voltage in a node is raised by the feed-in of reactive power; the intake of reactive power reduces the voltage[3]. swissgrid provides reference voltages for the feed-in nodes of power plants in the transmission system. The voltage at the feed-in point can be brought to the given reference voltage through the regulated exchange of reactive power.

The concept differentiates between the provisioning of reactive power capacity and the exchange of voltage-conformant reactive energy by power stations and distribution systems:

- Each power station must provide a mandatory reactive power volume, which must be available at any time if the unit is (synchronized) on the network.
- Contractual regulations are agreed with power plants for the supply of reactive power capacities. A bid process is not planned at present.
- The exchanged reactive energy is remunerated at a flat rate (CHF/Mvarh) in the entire capacity range.

4 Compensation for active power losses in the transmission system

Any transport of active or reactive energy in the network leads to active power losses. These losses of energy, which occur at all network levels, must be compensated for, i.e. energy must be produced or procured in addition to the energy delivered to end consumers, and fed into the appropriate grid. Active power losses vary at different network levels and depend on a range of factors. For example, the transit of electricity through Switzerland substantially affects losses in the transmission system.
Active losses of energy for the technically defined transmission system can be determined by calculating the difference of all measured feed-ins and withdrawals. Distribution grid operators are responsible for the procurement of active power losses in the distribution grid. The average active power losses in the Swiss transmission system amount to approx. 100 MW (with a range of approx. 60 to 200 MW).

Product-specific information can be found in the document «Principles of ancillary services products» [1].

5 Black start and island operation capability

Black start-enabled power stations ensure the restoration of the grid after major incidents. Special operational sequences and procedures are applied to coordinate the restoration of voltage to the grid. This necessitates a defined number of appropriately equipped power stations with the necessary auxiliary installations, which switch themselves on to the grid in the appropriate operational sequence at the grid operator's request and, in so doing, help to restore the grid. A power plant is capable of black-start if it can go from idle to operational without requiring the injection of grid-connected electricity. A power station is able to operate in isolation (island operation capability) if it can achieve and maintain a certain operating level without requiring activation of the outgoing lines to the synchronous grid.

[3] This is referred to as voltage-reactive power control or voltage support.

Provision of the ancillary service «Black Start and Island Operation Capability» is made via bilateral agreement with swissgrid[4].

6 System coordination

System coordination covers all higher-level services required at the transmission system level in order to coordinate and ensure the reliable, orderly operation of the transmission system in Switzerland as well as guarantee the integration of the Swiss transmission system in European grid operations. In particular, system coordination includes overall monitoring of the grid, grid management and control, the co-ordination of international energy exchange programmes, congestion management, as well as various other coordination activities within Switzerland and in the international grid. In terms of technical operations, essential tasks of system co-ordination include calculations to determine grid safety/security, operation of the Swiss load frequency controller and billing/settlement with neighbouring countries, monitoring the provision of system services and coordinating grid restoration following a major incident.
All these tasks are essential for the reliable, secure and stable operation of the grid, serve all grid customers and are performed by the Swiss grid company, swissgrid.

7 Operational measurement

This includes installation, operation and maintenance of the measuring and metering devices and data communications equipment and systems (communication) in the grid, as well as the provision of information (measuring data) to ensure the smooth operation of the grid. This also includes power handover measurements to neighbouring foreign grids. Operational measurements represent an important interface between the different grids. Installation and maintenance of the measuring and metering devices, measuring and metering data acquisition as well as transmission are guaranteed by the respective grid operator.

8 References

[1] swissgrid ltd., **Principles of ancillary services products**, the current, valid version of which is published on www.swissgrid.ch.

[4] The selection of the involved power plants is determined by the grid restoration concept.