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Overview of ancillary services

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Content

1 Ancillary services

Swissgrid is responsible for the secure, reliable operation of the Swiss transmission grid and for connections to the transmission grids of foreign operators. To this end, Swissgrid coordinates the operation of the grids with all grid connection consumers, such as neighbouring transmission grid operators or downstream distribution grid operators, and monitors the Swiss control area. To do so, Swissgrid requires ancillary services

Ancillary services in the electricity supply area are defined as services that are essential for the functioning of the system. Grid operators deliver such services to customers, in addition to transmitting and distributing electricity, and they thus determine the quality of the electricity supply. Ancillary services include:

- Frequency control (primary, secondary, tertiary control)
- Voltage support
- Compensation of active power losses
- Black start and island operation capability
- System coordination
- Balance group management
- Operational measurement

In accordance with Article 22 of the Electricity Supply Ordinance, from 1 January 2009 Swissgrid has purchased ancillary services using 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]). Swissgrid draws up the details of ancillary service provision. The contract scenario with the providers envisages signing a framework agreement 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. An overview of the various ancillary service products can be found in the document «Principles of ancillary services products» [1].

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

2 Frequency control

Electrical energy («electricity») cannot be stored in large quantities using 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 withdrawal of electrical energy from the grid must be balanced out at short notice by rapidly increasing or reducing the power plant output of the suppliers of what is referred to as the control reserve.

Frequency control is required if, in the current capacity balance of a control area, the sum of the actual capacities of all feed-in and withdrawal deviates from the sum of the expected capacities. This deviation can originate on the grid load side (for instance, as a result of meteorological influences or natural inaccuracy in the load forecast) and on the production side (for example, due to production restrictions or stoppages or 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.

Technically this is achieved within the ENTSO-E by using a three-stage control procedure (primary, secondary, and tertiary control). The following example assumes a power station failure. Primary control is

[1] UCTE was incorporated into ENTSO-E on 1 July 2009 and continues to exist as «Regional Group Continental Europe».

activated directly in the entire synchronous area. After 30 seconds, secondary control power is automatically called up, which is replaced by tertiary control after no more than 15 minutes.

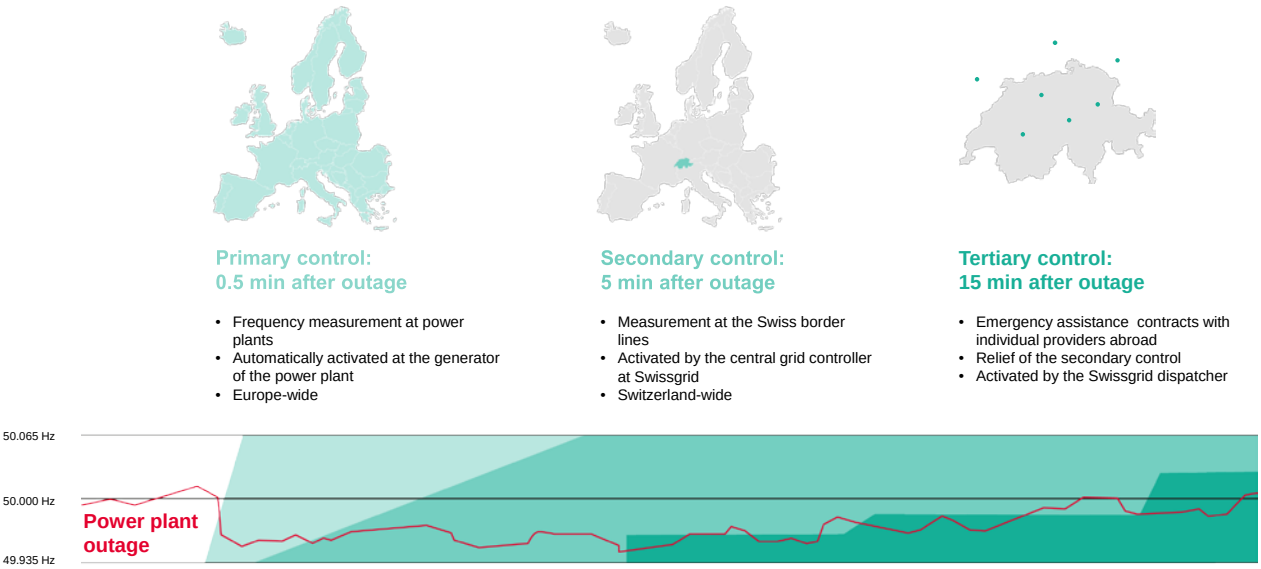

Figure 1: Example of a power plant outage.

2.1 Primary control

Primary control restores the balance between power generation and consumption within seconds of the disturbance 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 grid frequency is monitored and, in the event of deviations, the primary control power needed is activated. All transmission system operators represented in the synchronous area must fulfil the requirements in their country in accordance with the ENTSO-E rules: the primary control power capacity which must be kept in reserve at all times 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).

2.2 Secondary control

Secondary control is used to maintain the desired energy exchange of a control area with the rest of the synchronous area, using 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 prerequisite, these power stations must be in operation but must not be 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.

2.3 Tertiary control

Tertiary control reserves are used to replace the secondary control reserve in order to restore a sufficient secondary control band. The tertiary control reserve is primarily necessary for adjusting major, longer-lasting control deviations, particularly after production outages or unexpectedly long-lasting load changes. The Swissgrid dispatcher effectuates activation by sending 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.

3 Voltage support

The voltage at a grid node can be affected by the exchange of reactive power. The voltage at a grid node is raised by feeding in reactive power; the intake of reactive power reduces the voltage. Swissgrid specifies reference voltages for the feed-in and withdrawal points for generation units and distribution grid operators in the transmission grid. The controlled exchange of reactive power allows the voltage at the feed-in point to be brought to the specified reference voltage.

Active participation in voltage support is mandatory for all operating power plants directly connected to the transmission grid, Distribution grids and end customers are obliged to participate in the voltage support at a semi-active level. However, they can prequalify for active voltage support. The provision of reactive energy is contractually regulated in the company agreements. For the time being, no invitation to tender is planned. The replaced reactive energy is remunerated via a fixed tariff in addition to a uniform fee for participants. For mandatory voltage support, power plants have the option of participating in the supra-mandatory voltage support. Specific standard contracts regulate the provision of reactive power capacity. In addition to the remunerated reactive energy, specific remuneration is defined per start and operating hour for each power plant.

4 Compensation for active power losses

For physical reasons, any transport of electrical energy using a grid leads to losses, i.e. less energy can be withdrawn than is fed into the grid. These active power losses are proportional to the transported energy and amount to between 1% and 7% of the transmitted energy. It is primarily thermal energy that is emitted due to resistances in the environment. The longer a transport line and the lower the voltage, the higher the active power losses. The active power losses for the metrologically separate transmission grid can be determined by determining the difference between all measured feed-ins and withdrawals. Swissgrid is responsible for procuring active energy on the electricity market to compensate for transmission losses on the extra-high voltage grid. The average active power losses in the Swiss transmission grid amount to approx. 110 MW (with a range of approx. 60 to 200 MW).

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 certain 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 plant 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.

Four build-up cells have been defined for the «Black Start and Island Operation Capability» ancillary service for Switzerland. Each build-up cell must be able to independently initiate grid restoration measures. The ancillary services are provided by Swissgrid via an invitation to tender[2].

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 grid in Switzerland, which also involves guaranteeing the integration of the Swiss transmission grid in European grid operations. In particular, system coordination includes overall monitoring of the grid, grid management and control, the coordination of international energy exchange programmes, congestion management, as well as various

[2] The selection of involved power plants is defined by the restoration concept.

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 reliability, 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 secure and stable operation of the grid, serve all grid customers and are performed by the Swiss grid company Swissgrid.

7 Balance group management

Balance group management for the Swiss control area is provided by Swissgrid. This is the task of providing and operating a system so that generation and consumption are in equilibrium at all times. This is done using balance groups, which must be balanced using a scheduling system also provided for this purpose (balance group and schedule management). If this is not the case, balancing energy is used to compensate, and the imbalance of the respective balancing group is invoiced (balance compensation management). For this to be possible, a balance group must clearly assign its measuring points (measurement data management).

8 Operational measurement

This includes installation, operation and maintenance of the measuring and metering devices and data transmission 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 for neighbouring foreign integrated 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.

9 References

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