SYSTEM SERVICES AND EFFICIENT ENGAGING OF POWER SOURCES

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ABSTRACT

System services play important part of the process of the electricity production. There have been already many research projects concerning various aspects of system services, but the production of system services themselves has been so far neglected. This means that there is no discussion about the type of power plants involved (e.g. whether plants with condensing or back-pressure turbines or combined-cycle plants are taken into account). Each type of production brings specific aspects. This should be respected especially in the case of power and heating plants because otherwise a lot of heat can be wasted in attempt to provide system services. That is why an analysis of using power sources for system services from the point of view of technological principle of sources should be done taking into account the savings of fuel as well as the protection of the environment.

1 INRODUCTION

The state of electrical power networks is described by two basic quantities – frequency and voltage. Frequency is constant in all parts of grid, but voltage has a local character and changes in different parts of the power system. It is hard to influence the consumption of electric power because it's given by consumers. A balance between the production and consumption of electric power must be obtained by changes of electric power generation. System services provided by the operator of transmission system are used for maintaining key technical parameters of electric energy within set bounds. If system services are provided by a modern combined heating and power plant, a full report analysis must be done, such as in case of combined heating and power plant (CHP) Červený mlýn. The purchase price of this CHP plant is so high that since the start of its operation in 1998 the investment has not been returned yet. An analysis in order to increase its utilization – especially in summer time when there is no heat consumption – have been done.

2 SYSTEM SERVICES

System services represent an important part of the process of the production of electricity. They are used to keep basic quantities of electrical power networks within certain limits. Integrating renewable sources such as wind power plants into the electrical grid increases their importance. The main system services are:

- keeping a general power reserve for primary control,
- secondary control of frequency and transferred power,
- power tertiary control,
- providing an operational reserve,
- ensuring of transfer stability,
- voltage and reactive power tertiary control.

Facilities for the realization of system services at the employment market are provided by supportive services. The supportive services are:

- primary frequency control,
- secondary power control of plant unit,
- tertiary power control of plant unit,
- fast-starting reserve – 10-minute reserve,
- fast-starting reserve – 30-minute reserve,
- dispatcher reserve,
- change of load etc.

The operator of a power plant unit must satisfy special technical requirements so that it can provide supportive services. These exact requirements are described in grid code and they must be verified yearly. The operators of new and modern CHP's try to obtain this profitable position because the plants can be operated also during the summer period when there is no or minimum heat consumption.

3 COMBINED HEATING AND POWER PLANT

The CHP's are today the most effective power plants. They are equipped with a steam-gas combined turbine that achieves a high efficiency. It is composed of two serial heat circuits where heat energy is converted to electrical energy. One of the most important parameters of CHP's is specific heating plant production of electric energy

$$e = \frac{E}{Q_d} \tag{1}$$

where E is the amount of produced electric energy during supplying quantity heat Q_d. With growing specific heating plant production of electric energy (i.e. with growing production of electric power in a set heat amount, less electric energy should be produced in condensing plants with lower efficiency, which should lead to increasing the savings of fuel.

It is also the case of the CHP plant Červený mlýn. This new and modern (built 1998) CHP plant operates in heating period (October – March) as a source of heat and at the same time provides two supportive services (secondary power control of plant unit, tertiary power control of plant unit). The source is out of operation off the heating period.

Three different analyses of the utilization of this highly efficient source for supportive services have been made.

October – March period

a) CHP plant produces heat and provides supportive services

b) CHP plant is in reserve and provides supportive services

April – September period

CHP plant provides only supportive services

These analyses contain different types of supportive services that are in detail described in [3] and [4]. The case 1a) is the current state. The CHP plant is out of operation during summer season and so the power system loses a highly efficient source. The next alternative is very hazardous because of the maximum exploitation of other heat sources. In this case, there is also no heat reserve; by the way, from economical viewpoint alternative 1a) is much better. In the second summer period, it is impossible to ensure sufficient heat consumption, so the plant cannot provide a dispatcher reserve. A possible solution is to remove heat consumption of the CHP plant by installation of so-called bypass. This equipment leads hot burnt gas into smoke-stack instead of the second heat circuit with steam turbine. Power provided with bypass installation decreases the power output of the plant, so it must be taken into account in suggested supportive services. Among services which could be provided by this source are dispatcher reserve and fast-starting reserve (30-minute reserve). From the economic point of view, dispatcher reserve is almost twice better.

Therefore modern steam-gas combined turbines should be used as much as possible for system services.

4 CONCLUSION

System services and especially supportive services are one of the most important parts of the production and reliable distribution of electric energy. The utilization of new, modern combined heating and power plants with high efficiency rapidly decreases the amount of consumed fuel. They can be also for providing supportive services, such as dispatcher reserve and fast-starting reserve (30 minute reserve), which requires a fast and reliable action. An example of this possible application is shown in the analyses that have been made for the combined heating and power plant Červený mlýn in Brno.

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