Examples of changes in Romania power systems towards the achievement of the modern objective of the UE

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Abstract. One of the main scopes for power systems is the ensuring adequate and secure electricity service through intelligent planning, operation and reliability. In order to benefit today from the advantages of the intelligent production of tomorrow, the connection between the real production and the processes based on digital data is necessary. The devices using power electronic technology become a vital solution in many power system applications. Nowadays technologies are generating solutions variously increasing for the energetically management.

1 The bridge between energy independence and fast changing energy markets

From 1990 till nowadays, one by one, many primary energy facilities, like electrical or thermal power plants have been closed. The main reasons of closings relate to diminish of the economic activities, low profitability degree or implementation of environment standards. Even for the several types of energy activities that have been privatized or taken in concession, the core sources remain under governmental control.

To face the competitive energy market, the main target for energy exploitation capacities is to reconfigure their activities [1],[2]. This goal is achieved with great efforts, with major effects on local economic development and on general welfare.

As an EU member, Romanian exploitation sector is participant of the transition process, for the achievement of the common objectives of the EU.

The target is achieving an optimum with respect to energy mix (figure1), which is changing over time, in conjunction with the evolution of production capacities and national energy strategy.

The energy mix will be in equilibrium touch as:
• hydro: 25% (2017) – 26% (2030)
• nuclear 17% (2017) – 16% (2030)
• wind 8% (2017) – 22% (2030)
• solar 2% (2017) – 6% (2030)
• coal 34% (2017) – 5% (2030)

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• natural gas 12% (2017) – 21% (2030)
• biomass 1% (2017) – 3% (2030)

Fig. 1. The structure of electricity generation

The evolution of energy demand and primary energy resources on international markets eliminates scenarios based on the lower cost of energy [3]. Improving the energy efficiency, growing the RES (renewable energy source) using and diversity of power electronic technologies solutions for the energy supplies, represent priority for the EU countries.

2 The importance of modern control of the energetic process

Energy is a product with great economic, social, strategic and political values. It is indispensable for any country’s economy as for industries, services and human activities. For avoiding some events as blackouts that can affect the interconnected power systems, the system operators are seeking efficient solutions and tools for operating the power grid in good, economical and regulatory conditions [4].

Technological advances can provide today an automated and better standardized process that achieves consistent production levels from previously less efficient processes. Modern power systems are complex, interconnected and involve thousands of busses and hundreds of generators. Power system protection devices also form an important part of the system. Environmental as well as economic factors govern the installation of new power systems and to transport this power, new transmission lines construction are needed to meet the ever increasing load demand. Modern control techniques and management strategies emphasize current trends in the field, as well as the evolution of energy balance influence on the environment [5], [6].

The energetic process command can be modeled like shown in figure 2, where the informatics system operation correlated with dynamic evolution of process stage, is characterized by:
- flexibility and adjustment of a large variety of situations;
- increasing of automation degree;
- increasing of measurements precision;
- high reliability through implementation of power electronic components;
- equipment miniaturization;
- due to the standardized components which involve standard interconnections, the electronic and technological design is simplified.

As the technology is advances, the applications are also developed at the distribution system level. A customized approach supports the principal need for technological solutions:
- increasing the level of automation;
- increasing accuracy,
- implementation the modern management tools.

The devices using power electronic technology become a vital solution in many power system applications and are the solution to increase the transmission capacity or to control the voltage or power flow [7].

Advances in power electronic technologies together with sophisticated electronic control methods made possible the development of fast static compensators namely Flexible AC Transmission Systems (FACTS)[7], [8]. The FACTS technology has become one of the most valuable compensation techniques, because it applies the latest advances in power electronics to achieve additional and more effective control of the parameters of the electrical systems (fig.2) This represents the most efficient combination of conventional primary equipment, high power semiconductor devices, microelectronics and telecommunications equipment, allowing a most flexible power electric system.

The modernization of measurement equipment takes into account more than smart metering and the replace of classic current and voltage measuring transformers through unconventional sensors and transducers as: Rogowski coil, Hall sensor, (FOCS)- fiber optical current sensor etc., have an important advantage in customers protection [9].

The monitoring system and its main function is to simultaneous monitor the voltage as well as power flow in a transmission line, making possible to optimize the operation of the power system, and transmit these parameters via a telemetry network to a SCADA system.

![Fig. 2. The main elements of updated control using FACTS and SCADA](image)

The basic elements for a modern control system are:
- the interfaces between real time control system and FACTS elements using optical fibers;
- measurements and signal processing circuits for miscellaneous devices, protection relays;
- the monitoring and supervisory control system;
- the customer’s user interface provided by LCD panel using an even serial or Ethernet web (to collect informational environmental parameters like temperature and humidity, status of ventilation and many more operational essential parameters).
3 Management requirements as part of intelligent power system

Nowadays technologies are generating solutions various increasingly for the energetically management. The energy management is the one of market’s instruments which is used to remove the inefficiencies (figure3) [10].

![Fig. 3. Management measurements for increasing energy efficiency](image)

The main advantage of the measurement system controlled by PC, when compared with the classic methods of measurements, is given by the wider varieties of configurations (figure.4). The solutions and intermediate results have to be repeated for every domain in the case of using classic apparatus, while the PC numeric measurement system realizes the same function by only changing the customer’s interface.

![Fig.4 The software functions for smart measurements systems](image)

Using standard software (S-Soft) associated to measurement devices, we can achieve modern data acquisition, process monitoring and control and results analysis [11].
Fig. 5 Standard elements through the computerized measurements system

The standard solutions in the software area can emphasize more aspects, as shown in above figure. It should also take into account the compatibility between different software productions which have the purpose to fulfill the same scope or function (figure5).

Basically, the smart mining industry incorporates the combination of information and communication technologies into the electric transmission and distribution networks for mining process.

4 Conclusions

Bringing the Romanian energy sector at the high efficiency operating parameters of the modern times can be realized through implementation the modern management system, smart metering and power electronics devices, solutions which have a huge impact on future electrical supply systems and will lead to many benefits, including financial ones.

References

1. A. Leca, V. Musatescu, Managementul energiei (Agir, Bucuresti, 2007)
2. V.Vaida, Politici, strategii, dezvoltare (Agir, Bucuresti, 2015)
3. D.A Ciupageanu, G. Lazaroiu, L. Barelli, Proceedings of the 18th International Multidisciplinary Scientific Geoconference SGEM 2018 18, 469-477, (2018)
4. D.Pasculescu, L.Pana, s.a Mining of Mineral Deposits 13, 1-16, (2019)
5. D.A Ciupageanu, s.a. Proceedings of the 14th IEEE International Conference on Development and Application Systems DAS2018 14, 26-30, (2018)
6. D.A Ciupageanu, s.a. Proceedings of the IEEE International Conference on Electromechanical and Power Systems SIELMEN 2017, 281-285, (2017)
7. M Eremia, s.a, Dispozitive FACTS, Concepte si aplicatii in electroenergetica (Agir, Bucuresti 2017)
8. M.D. Stochitoiu, Annals of University of Petrosani, Electrical engineering XLVI, 35-39, (2017)
9. C.I. Golovarov, Masurarea marimilor electrice in sistemul electroenergetic (Academiei Romane, Bucuresti, 2009)
10. M.D. Stochitoiu Proceedings of the 18th International multidisciplinary Scientific Geoconference SGEM 2018 18, 591-596, (2018)
11. C.Stefanescu, s.a, Sisteme inteligente de masurare si control (Albastra, Cluj, 2012)