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THE IMPORTANCE OF INTRODUCING MODERN MANAGEMENT STRATEGIES IN THE POWER SYSTEM AND THE ROLE OF DIAGNOSTIC CENTER IN IT

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In the Electric Power System (EPS), as a technically complex and distributed system with a layered organizational and management structure, it is very important to improve the electricity production, distribution and transmission, as well as introduce the new management and decision-making strategies. The paper presents the place and role of currently actual strategies, theories and algorithms of management and decision making with their basic characteristics.
Several management strategies and engineering approaches have been modified and adapted to the needs of EPS. Modified and improved asset management (AM) strategy is presented in detail, which can be, partly or in whole, applied at all levels of governance and making decision.
A significant place in the work occupies a description of the diagnostic center (DC). Its potential role in the in the EPS hierarchy is described in detail.

Keyword:*Electric power system, asset management, making decision, diagnostic centre.*

1 Introduction

In the last ten years, in the electricity sector, it is noticeable to introduce and implement a number of theories and strategies in order to improve the business. From a technical point of view, the various strategies and theories are applied in the areas of management, maintenance, control and remote monitoring. From the aspect of decision making and planning, the application of new theories and strategies is significant because it directly affects the increase in energy efficiency, cost reduction, rational planning and decision making based on comprehensive analysis of expert teams, thereby reducing potential malfunctions caused by insufficient information and/or untimely analysis.

Today's trends and financial climate in the electricity market dictate the constant need for improving the performance of the Electric Power System (EPS). The main electricity entities are composed the electricity production, transmission and distributive capacities (traditional division, Fig. 1) [1].

In the last decades, the trend in deregulation in the electricity sector is noticeable. It is reflected in the permanent transition from uninhabited monopolies, most often state-owned, to a significant liberalization of the entire EPS. It was noted that this process defines different business conditions and introduces new strategies in the field of planning, management and maintenance. In other words, in the conditions of a deregulated market, it is necessary to change and improve the traditional approach to management using new business models, algorithms and methodologies. Significant novelty is that the deregulated market is affected by users, most often through companies that are engaged in the electricity trade.

One of the changes proposed in this paper is the introduction of diagnostic centre (DC) with its dual role: part of the management of EPS (only in terms of giving suggestions), as well as an independent entity when it comes to remote monitoring, equipment assessment, strategic analysis, and planning. The general concept of the DC (for remote monitoring of production and exploitation parameters) involves the use of modern monitoring measuring equipment with the aim of early fault detection and increased production reliability. Early fault detection is possible thanks to sophisticated remote monitoring systems and fits into a modern state-of-the-art maintenance concept such as condition-based maintenance etc. Increasing reliability is a direct result of the reduced number of forced outages and affects the increase in production efficiency.

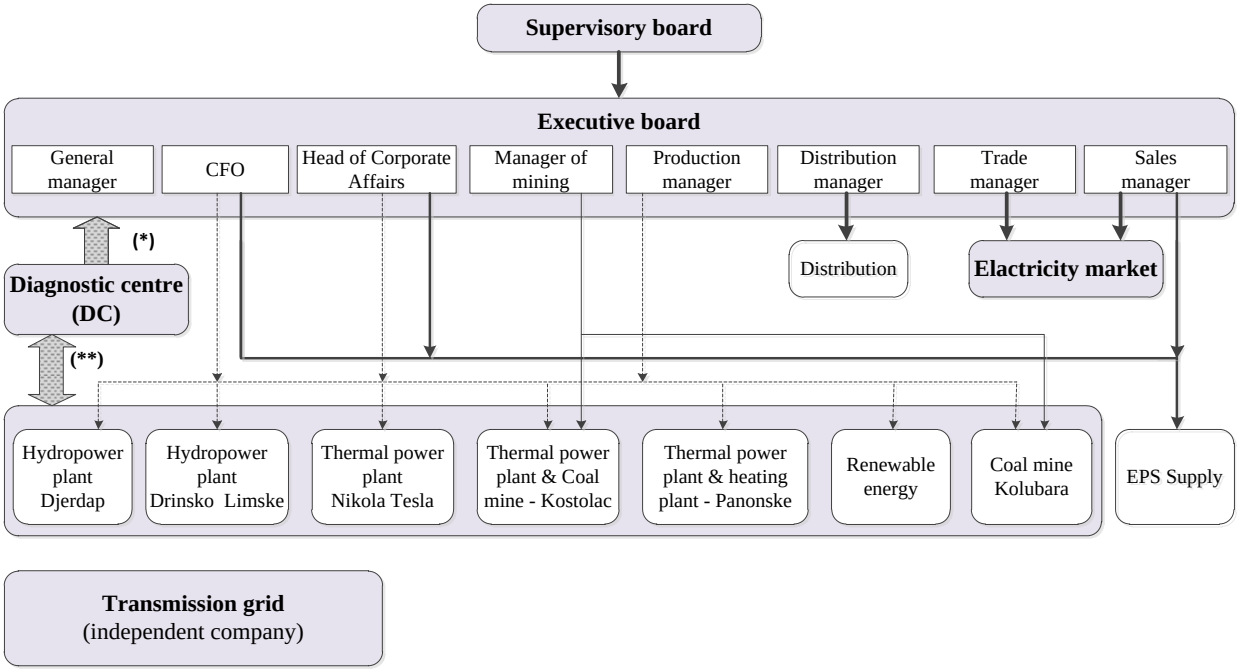

Fig. 1 Organization tree of Electric Power System of Serbia (EPS)

It is important to underline that the DC concept represents the upgrade of the existing power control concept and its introduction should not disturb any of the existing control and monitoring systems. Diagnostic centers are formed in the world and conceptually represent novelty in the management and remote control of power plants [2 - 6].

2 Management strategies

Asset management (AM) has been defined as follows [IEEE Technology Navigator]: "Asset management is a systematic process of deploying, operating, maintaining, upgrading, and disposing of assets cost-effectively." One of the first questions to be asked in constructing the practically applicable algorithm based on AM is what is important to the power plants. Fig. 2 shows the newly developed AM strategy which main aim is to implement all the previously mentioned. This algorithm is basic conception (with a little correction) of AM strategy. The broad practise of asset management can be divided into several different functions. Based on a review of CIGRE TB 541, asset management can be classed as follows:

- Condition assessment and asset monitoring
- End of life issues
- Asset management decision making and risk management
- Asset development
- Maintenance processes and decision making
- Collection of asset data and information

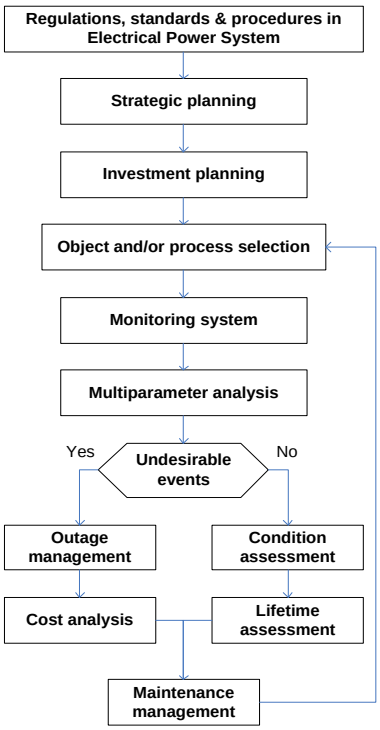

Fig. 2 Adapted AM strategy - basic framework [3]

3 Diagnostic Centre (DC)

The electricity market, like any other market, is exclusively driven by economic considerations. Diagnostic centre should be competence centre of power system with the primary aim to monitor and control the electricity production on the level of big

electricity companies and/or whole countries and regions. Fig. 3 shows developed comprehensive concept of the complete monitoring of capital production units in power plants. Presented concept includes existing structure of the monitoring and maintenance systems of power plants within entire electric power industry and upgrades it to the diagnostic centre.

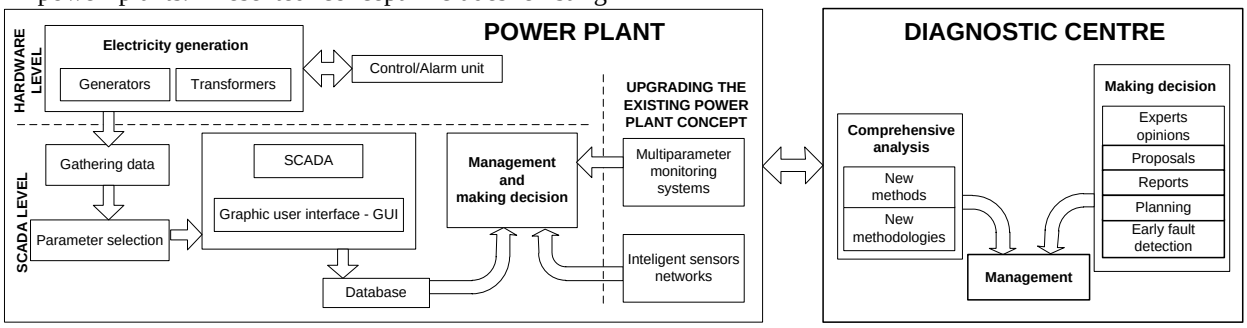

Fig. 3 The role of a diagnostic centre in the control and monitoring of power plant

DC concept should allow the following:

- DC should enable monitoring, protection and automated optimization of the work of all parts of the power system - from central and distributed sources (generators), through the transmission and distribution network to industrial consumers and households.
- Higher level of integration of data obtained from the measurement history with data obtained from different intelligent sensors and remote monitoring systems.
- Implementation of modern protocols and standards.
- Better maintenance planning of all types of maintenance with the goals of reducing maintenance costs.
- Planning investments in new sophisticated measurement and monitoring networked systems.
- Continuous monitoring of individual urgent parameters.
- Data gathering (over the computer optical or wireless network, standalone or networked remote monitoring systems and complex smart sensors, experts systems, SCADA, old reports…).
- Comprehensive methods for data processing and data analysis.
- Timely multiparameter analysis, calculation and processing of relevant parameters using a database of knowledge, modern software techniques and tools with the aim of assessment of the state of capital equipment, as well as monitoring of complete technological processes.
- Continuous expansion of the communication and computer network and the network of remote control and monitoring systems.
- Raising the level of reliability and protection of the electricity production.
- Giving expert opinions in characteristic situations or for a longer period of time.
- Risk analysis.
- Risk assessment.
- Risk management
- Estimation of the remaining lifetime of capital equipment.
- Maintenance management
- Making decision.
- ...

In the process of DC design, several theories and strategies were involved: asset management, risk management [7,8] (with risk analysis and risk assessment), smart-grid concept and operational excellence theory [9]. Special attention is paid to the decision-making process. In addition to the existing recognized solutions, which can be found in scientific and technical literature, the authors of this paper recognized the usefulness of fuzzy theory in the in making decision algorithms.

EPS is a very complex system and decision-making based on a large number of heterogeneous data and information is a complex and demanding process. This process is further complicated when it entails different attitudes and opinions of the expert, or if there is insufficient information, some of which are even unreliable. In order to overcome these problems, Lotfi Zadeh developed a theory of Fuzzy Logic in 1965, at Berkeley University in California. The fuzzy logic is based on the theory of the fuzzy of sets [10]. Fuzzy sets are convenient mathematical apparatus for treating uncertainty, subjectivity, versatility and uncertainty. The basic structure of the fuzzy control systems is given in Fig 4.

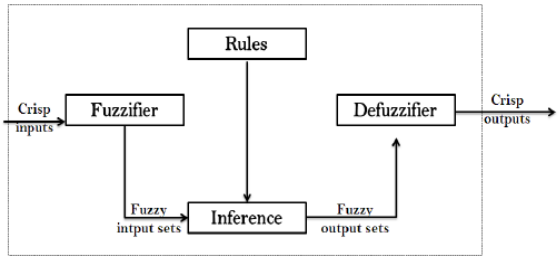

Fig. 4 Fuzzy control system – basic structure

4 Conclusion and suggestions

Today's trends and financial climate in the electricity market dictate the constant need for improving the performance of the power electricity system (EPS). The paper pointed out the need to introduce modern concepts of management in the EPS such as asset management (AM) etc. Application AM strategy of monitoring and fault detection should enable better management and planning. A modified and customized general concept of AM is presented in detail. A detailed concept of DC and its role in the structure of the EES is presented. DC is expected to provide additional quality and improve the existing control of process and production parameters in the power plants, without disturbing existing measuring and monitoring concepts.

The proposal to introduce DC in EPS takes place in two phases. The first phase implies that DC performs remote control and monitoring only of the power plants (see Fig. 5), while in the second phase DC will be included in the decision-making cycle at the higher management level (only as an advisory body) (see Fig. 6).

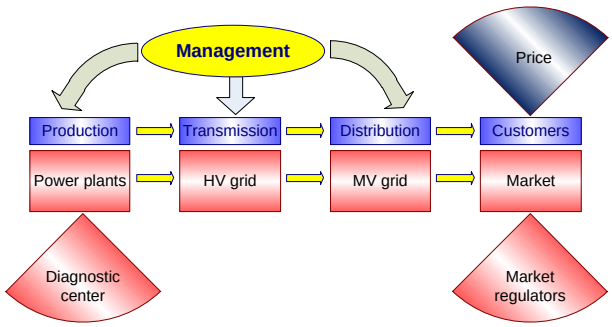

Fig. 5. DC role in power plant monitoring and control

Fig. 6. DC role in the decision-making cycle

The formation of DC in the electricity sector within large companies, even at the state level, is a qualitatively new and more advanced approach in the remote control and monitoring of the entire EPS. DC should bring profit to the entire energy sector from the aspect of investment, energy efficiency, maintenance and sustainable development. Due to the projected role of DC, strategy management and decision-making, which should be represented in DC are of the vital importance, both in terms of users and in terms of development planning and investment.

5 Acknowledgements

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