Efficiency and effectiveness of the operation, development and competitiveness of MEP "Oslomej"

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Abstract

Electricity production represents an important economic activity, which is not in the phase of maturity, nor decline, but has a rather promising development future and is the most important factor for the socioeconomic development of a country.
Therefore, the subject to be elaborated in this paper is very much up to date due to the fact that it includes the essential aspects related to electricity, and in this context, the attention will be focused on the detailed and practical processing of selected data concerning the management of production, human resources and the price of produced electricity per generator in Thermo power plant (TPP) "Oslomej", as well as the various activities related to more successful operation and production increase.
The analysis in this paper focuses and aims to show the importance and influence of these aspects on the management of the industrial plant, as well as improvement of its effectiveness and efficiency of operation and development. All of this will have an important role and direct impact on the creation and increase of the organizational competitiveness, which is still not present because of the regulated production capacities, but is expected after full liberalization of the electricity market in the Republic of Macedonia.

Keywords: efficiency, effectiveness, development, competitiveness, electricity.

Introduction

An important segment for the development of the economy of each country is of course the sector of electricity production together with its production facilities. In this sense, the Mining and energy plant (MEP) Oslomej as the second largest production facility part of ELEM JSC, is very important for the electric energy system as a whole, in terms of employment and economic development of the municipality, the region and the country. The plant has an installed capacity of 125 MW, and produces about 10% of the electricity in the Republic of Macedonia. The total electricity production for the period 1980-2015 amounts to 17,046,099 [MWh], which represents 85.4% of its total planned production of 19,968,172 [MWh], reaching an average annual production of 473,503 [MWh].
Taking into consideration all of the above, as well as the need for an increase in electricity production in the country in general, related to ELEM JSC, and especially in MEP Oslomej, the purpose of this paper is to show the current operation of MEP Oslomej and the possibilities for improvement of the efficiency and effectiveness of the future operation and development of the plant. This includes preparation and modification of the industrial plant to operate in conditions needed in order to accomplish and sustain competitive advantage in a fully liberalized electricity

market in the Republic of Macedonia. Here, according to the relevant European Directives, one should take into account the activities related to the improvement of the environmental aspect of the plant's future operation through modernization and refinement of the technological processes, in order to contribute to environment sustainability and protection.

In this context, the paper contains four parts. Further, the analysis shall cover the observed period 2008-2015, largely focusing on the comparison of the data between the two four-year periods 2008-2011 and 2012-2015. The first part contains an analysis of the current operation of MEP Oslomej, which is related to the management process of the electricity production. The second part refers to the management of the human resources in MEP Oslomej. The third part of this paper is related to pricing management of electricity produced per generator in MEP Oslomej and its comparison to the price regulated by the Energy Regulatory Commission (ERC) for the electricity produced by ELEM JSC, the average price of electricity for households, as well as the price of imported electricity in the Republic of Macedonia. The fourth part comprises an analysis of the obtained information and identifies the characteristic activities which should be introduced in order to improve the efficiency and effectiveness of the future operation process, that will lead to greater success and further improvements as well. Moreover, the main purpose for the plant is to continue with its operation and to increase the production in order to meet the increasing demand of the consumers in the Republic of Macedonia in conditions of full liberalization of the electricity market. And finally the paper ends with a number of conclusions.

This paper is of great importance with regard to energy, economic, social and environmental aspects because, it analyzes both the present and future operations in terms of effectiveness and efficiency, including the creation of sustainable competitiveness of the company in a fully liberalized market as well. With this MEP Oslomej would contribute to the fulfillment of these aspects, and would enable us to join the modern and technologically advanced countries, bringing us a step closer to integrating in to the EU.

Management of electricity production in TPP Oslomej in the period 2008-2015

In the period 2008-2015, MEP Oslomej participated with 7.73% in the total electricity production of ELEM JSC, but held a share of 10.08% of ELEM's electricity produced by thermal power plants. The remaining share of 89.92% was produced by the energy plants of MEP Bitola, which have a combined installed capacity of 675 MW.

The total electricity production from thermal power plants in ELEM JSC, with a combined installed capacity of 820 MW, for the observed period, amounts to 33,595 GWh, or 76.66%, from hydropower plants with a combined installed capacity of 580 MW it amounts to 10,036 GWh, while the wind park Bogdanci, which was commissioned in 2014, and has an installed capacity of 35 MW, produced 192GWh of electricity or 0.44% from the total production of ELEM JSC. The total installed capacity of all power plants is 1436 MW.

Table 1 Electricity production in ELEM JSC and MEP Oslomej in the period 2008-

2015 (ELEM JSC, 2008-2015; TPP Oslomej, 2008-2015)

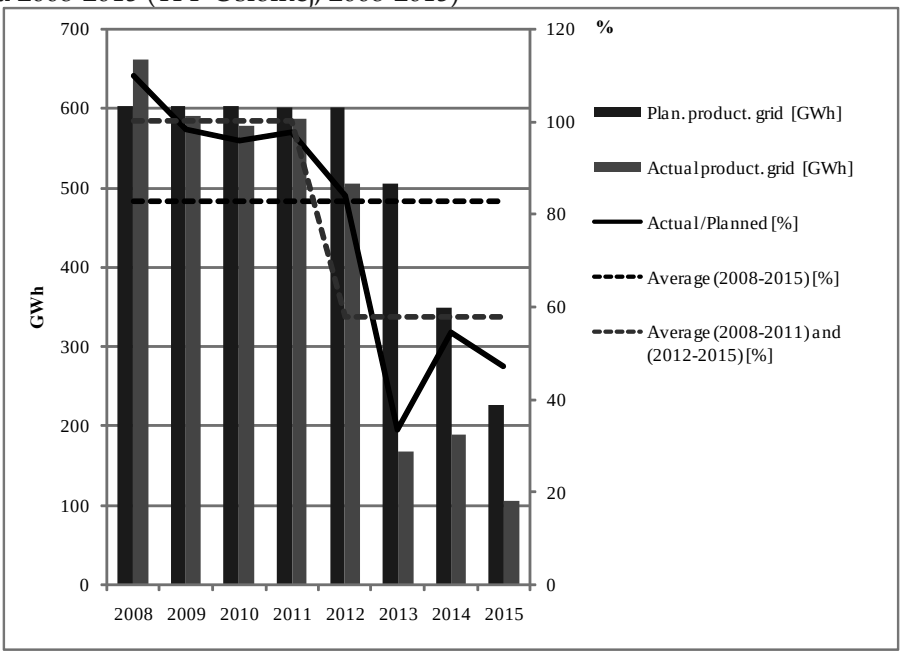
	2008	2009	2010	2011	Average	2012	2013	2014	2015	Average
ELEM JSC										
1.Production ELEM [GWh]	5615	5886	6462	6044	**6002**	5370	5113	4565	4768	**4954**
a. TPP of ELEM [GWh]	4877	4788	4277	4776	**4680**	4483	3750	3531	3113	**3719**
b. HPP of ELEM [GWh]	738	1098	2185	1268	**1322**	887	1363	963	1534	**1187**
Subsidiary TPP Oslomej										
2. Plan. produc. grid [GWh]	603	603	603	601	**603**	601	505	349	227	**421**
3.Actual produc. grid [GWh]	661	591	578	587	**604**	505	169	190	107	**243**
4.Actual/ planned [%]	109.7	98.1	95.8	97.6	**100**	84.0	33.5	54.4	47.1	**57.7**
5. Actual produc. ELEM [%]	11.77	10.04	8.94	9.71	**10.06**	9.40	3.30	4.16	2.24	**4.90**
6.Actual produc. per generator [GWh]	729.6	660.2	642.5	655.4	**671.9**	568.7	194.9	218.2	125.6	**276.9**
7.Consumed coal [10^3 t]	1156	1044	1013	1079	**1073**	948	354	391	235	**482**
8. Spec.cons. of coal [kg/ kWh]	1.58	1.58	1.58	1.66	**1.6**	1.69	1.88	1.86	1.87	**1.74**
9. Fuel oil consumed [t]	3542	4901	3364	4679	**4122**	6892	5791	7935	6511	**6782**
10.Spec.cons. of fuel oil [g/kWh]	4.9	7.4	5.2	7.1	**6.13**	12.1	29.7	29.7	51.8	**24.50**
11.Calor. value of coal[TJ/10^3 t]	6.679	6.670	6.661	6.461	**6.618**	6.442	6.036	5.927	5.444	**6.141**
12.Energ. effic. coeffic.[6/ (7+9)]	0.334	0.332	0.336	0.329	**0.333**	0.321	0.296	0.298	0.293	**0.308**
12.Plan. time of operation [h]	7320	7296	7296	7296	**7302**	7656	6552	4368	2880	**5364**
13.Actual time of opearaion [h]	7183	6935	6629	6862	**6902**	6273	2281	2589	1657	**3200**
14.Actual/Planned [%]	98.1	95.1	90.9	94.1	**94.5**	81.9	34.8	59.3	57.6	**59.6**
15.No. of shutdown / overhaul	5	10	12	16	**10.75**	17	7	8	6	**9.5**
16.Tot. time out of operation [h]	1601	1825	2131	1898	**1864**	2511	6479	6171	7102	**5566**

The production of electricity planned by MEP Oslomej (Table 1) was reduced due to lack of coal in 2013, and then additionally reduced in 2015 by 35% compared to 2014, by 55% compared to 2013, and by 62% compared to 2012. Despite the reduced planned production, there is further potential reduction in actual production, starting from 2012 onward.

The actual production is equal to the planned production in the period 2008-2011 and accounts to 100%, while in the period 2012-2015 it was drastically reduced and amounts to 57.7%. The actual production in the four-year period 2008-2011 amounting to 100% is 14.6% higher compared to the production up to date, i.e. the actual total production amounts to 83.4% for the period 1980-2015, while for the period 2012-

2015 it is 27.7% lower. Compared to the actual production of 82.8%, for the observed period 2008-2015, the production in the period 2008-2011 is 17.2% higher, while the production in the period 2012-2015 is 25.1% lower (Diagram 1). The actual production in the period 2008-2011 is 2.5 times higher compared to the production in the period 2012-2015.

Diagram 1 Planned and actual production of electricity in MEP Oslomej in the period 2008-2015 (TPP Oslomej, 2008-2015)



Regarding the consumption of coal for electricity production in MEP Oslomej, for the period 2008-2015, it is directly correlated with the produced electricity per generator, as well as with the calorific value of coal, while the consumption of fuel oil, especially in the period 2012-2015 drastically increased, despite the reduced electricity production. The consumption of fuel oil in the period 2012-2015 averages 6782 tons per year, and is 1.64 times higher compared to the average annual consumption of 4122 tons in the period 2008-2011. Contrary to this, in the period 2012-2015 the coal quality, i.e. the calorific value of the coal decreased and amounted to an average 6141 kJ/kg compared to the period 2008-2011, when this value was 6618 kJ/kg.

In the four-year period 2012-2015 the average annual specific coal consumption of 1.74 [kg/kWh] for produced electricity per generator is 8.05% higher than the annual average for the period 2008-2011 when it amounted to 1.6 [kg/kWh]. For the same period (2012-2015) the average annual specific consumption of fuel oil of 24.50 [g/kWh] for produced electricity per generator also drastically increased, i.e., was 4 times higher than the annual average for the period 2008-2011, when it amounted to 6.13 [g/kWh]. The average specific coal consumption in the observed period 2008-2015 amounted to 1.67 [kg/kWh], while for the fuel oil the same value amounted to

15.32 [g/kWh].
In TPP Oslomej, the past four years (period 2012-2015), the energy efficiency coefficient of 0.308 is lower compared to the period 2008-2011, when it amounted to 0.333. In the past four years, the total operation time out and the time spent in overhauls is 5,566h in total, which has drastically increased, i.e. it is almost 3 times higher compared to the period 2008-2011, when it amounted to 1864h. Contrary to this, the time spent in operation in the period 2012-2015 is 3200h and is 2.15 times lower compared to the period 2008-2011 where it was 6902h. All of this has a direct impact on the reduced actual electricity production by TPP Oslomej.

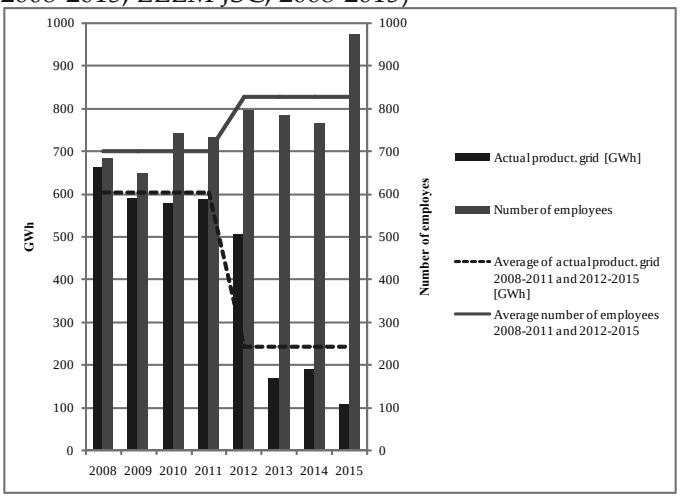
Management of human resources in MEP Oslomej for the period 2008-2015

Regarding the employment in ELEM JSC, the number of employees varies year after year. In 2012 this number substantially increased and reached a number of 4732, which is an increase of 709 employees or 18% compared to 2011. Then, in 2013 and 2014 there is a decrease of the number of employees, while in 2015, with a decision made by the Government of the Republic of Macedonia and adoption of a particular law, where the number increased to 4772 employees, that is, 274 newly employed, or a 6.1% increase compared to 2014 (Law on transformation in permanent employment, 2015, p.3). The average number of employees per GWh in the period 2012-2015 increased 1.4 times and amounted to 0.94 employees/GWh, compared to the period 2008-2011, when it amounted to 0.67 employees/GWh. This is as a consequence of the drastic decrease in production, along to the increase in the number of employees as well. The average value of the employees in the observed period 2008-2015 amounted to 0.79 employees/GWh.
Since the establishment of MEP Oslomej, the number of employees has grown constantly and in 2012 reached the number of 794, as a result of the takeover of 83 workers from "Separacija" and "ROI". In 2013 and 2014, there is an insignificant decrease of the number of employees, due to regular retirement and leaving the company through the "Programme for voluntary termination of employment with severance pay", and also as a result of not having new employments. In 2015, due to adoption of the abovementioned Law, the number of employees increased to 972, having 208 new employments, or a 27% increase compared to 2014. This is due to the 229 new employees; 182 in the first phase and 47 in the second phase. The average number of employees per GWh in MEP Oslomej for the period 2012-2015 increased 2.9 times and was 3.4 employees/GWh, compared to the period 2008-2011, when this number was 1.16 employees/GWh. This also points out to the fact that although there is a drastic decrease of production, there is still even more drastic increase of employment (Diagram 2). The average value of the observed period 2008-2015 amounts to 1.8 employees/GWh.

Table 2 Employment numbers in ELEM JSC and MEP Oslomej in the period 2008-2015 (ELEM JSC, 2008-2015)

	2008	2009	2010	2011	Average	2012	2013	2014	2015	Average
ELEM JSC										
2.No. of employees-ELEM	4033	3809	4210	4023	**4019**	4732	4682	4498	4772	**4671**
3.Employees / GWh - ELEM	0.72	0.65	0.65	0.67	**0.67**	0.88	0.92	0.99	1.00	**0.94**
Subsidiary MEP Oslomej										
14. No. of employees	681	647	741	732	**700**	794	783	764	972	**828**
15.Employees/ GWh at grid	1.03	1.09	1.28	1.25	**1.16**	1.57	4.63	4.02	9.12	**3.4**

Diagram 2 Production and employment in MEP Oslomej in the period 2008-2015 (TPP Oslomej, 2008-2015; ELEM JSC, 2008-2015)



Price management of produced electricity per generator unit in TPP Oslomej for the period 2008-2015

The average value of the price of electricity produced per generator in TPPP Oslomej for the period 2012-2015 amounted to 99.69 €/MWh and was 2.15 higher compared to the average for the period 2008-2011 when it amounted to 46.23 €/MWh. The average value for the observed period 2008-2015 amounted to 61.83 €/MWh.

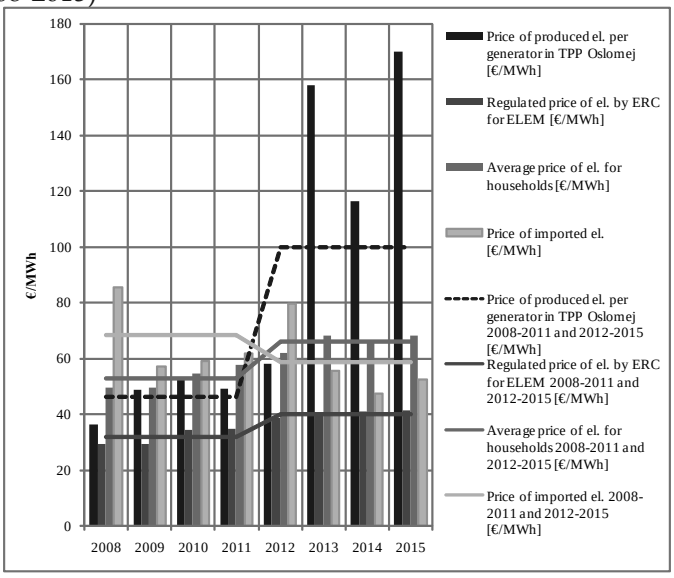
Table 3 Prices of electricity for the period 2008-2015 (TPP Oslomej, 2008-2015; ERC of R. Macedonia 2008-2015a; ERC of R. Macedonia 2008-2015b; National Bank of the Republic of Macedonia, 2008-2015)

Year	2008	2009	2010	2011	Ave rage	2012	2013	2014	2015	Ave rage
1. Price of produced el. per generator in TPP Oslomej [€/ MWh]	36.04	48.53	52.61	48.99	**46.23**	57.92	157.9	116.2	169.8	**99.69**
2. Regulated price of el. by ERC for ELEM [€/MWh]	29.05	29.05	34.3	34.5	**31.72**	38.54	39.69	40.90	41.04	**40.04**
3. Average price of el. for households [€/MWh]	49.43	49.43	54.30	57.40	**52.64**	61.78	68.00	66.00	67.96	**65.93**
4. Price of imported el.[€/MWh]	85.51	57.00	59.08	61.77	**68.42**	79.80	55.66	47.53	52.36	**58.45**
5. Imported el. [GWh]	2747	1565	1420	2676	**8408**	2465	2296	2960	2288	**10009**
6.Electricity [million €]	234.9	89.2	85.9	165.3	**575.3**	196.7	127.8	140.7	119.8	**585.0**

The regulated electricity price (by ERC) for ELEM and the average price of electricity for households in the period 2012-2015 increased to 40.04 €/MWh and 65.93 €/MWh, respectively, compared to the period 2008-2011, when prices amounted to 31.72 €/MWh and 52.64 €/MWh, respectively. The average value for the observed period 2008-2015 amounted to 35.88 €/MWh and 59.29 €/MWh, respectively.
On the other hand, the price of imported electricity decreased in the period 2012-2015 and amounted to 58.45 €/MWh compared to the period 2008-2011 when it amounted to 68.42 €/MWh. The average value in the observed period amounted to 63.00 €/MWh.

Taking into consideration all of the above, and the price comparison (Diagram 3) concerning the observed period (2008-2015), one can conclude that the price of produced electricity per generator in TPP Oslomej was above the regulated price for ELEM JSC, however, until 2012 it was below the average price for households and the price of imported electricity, while in 2013, 2014 and 2015 it drastically increased and was above these two categories. The increase is 2.32, 1.76 and 2.5 times compared to the electricity for households, respectively, and it is 2.82, 2.44 and 3.24 times higher compared to the price of imported electricity for the respective years.

Diagram 3 Comparison of electricity prices for the period 2008-2015 (TPP Oslomej, 2008-2015; ERC of R. Macedonia, 2008-2015; National Bank of the Republic of Macedonia, 2008-2015)



All of this is a result of specific increase in consumption of coal and fuel oil, reduced quality of coal, drastic decrease of actual production, reduction of the energy efficiency coefficient and extended periods out of operation, as well as increased number of employees per GWh. More precisely, this means an increase of the produced electricity price per generator in TPP Oslomej, especially in the last four-year period (2012-2015), due to the reduced revenue in conditions with same or slightly reduced but

still high expenditures. With such high price of produced electricity per generator in TPP Oslomej, one should bear in mind the company's competitiveness, especially in conditions of liberalization of the electricity market, although this obligation should have been implemented for households starting from 01.01.2015 (Law on Energy, 2011, p.61). However, its implementation was delayed and should be completed in the year 2020 (ERC of R. Macedonia, 2014, p.4). This will enable the consumers the selection of their future suppliers and therefore procure electricity at market prices.

Management of activities for improvement and increase of the performances of MEP Oslomej

Organizational performance increases proportionally with the increase of efficiency and effectiveness. The efficiency is a measure for how well or how productive resources are used for achieving the goal, while effectiveness is a measure for the adequacy of the objectives managers have chosen to perform for the organization, and the degree to which the organization achieves these goals (Gareth R. Jones, Jennifer M. George, 2008, p.6).

Energy efficiency enables the usage of energy resources on the long run, by implementing the most important efficiency measures in MEP Oslomej. These include selection, granulation and homogenization of coal, monitoring of the technological process and maintenance of the set parameters, maintenance of the vacuum in the condenser within the set parameters, reducing the number of planned and unexpected shutdown sequences, reduction of the total duration of periods out of operation, reduction of the electricity consumption by the plant itself, operating the block with constant nominal power (120 MW) etc.

Improving the energy efficiency contributes to the reduction of the emissions of harmful gases, as well as the generated waste in the environment, reduction of the specific coal and fuel oil consumption respectively, increase of actual production, thus reducing the employment coefficient per GWh, as well as reducing of the produced electricity price. All of this would provide an increase in the performances of MEP Oslomej and create sustainable company competitiveness.

Recently, the planned production of TPP Oslomej has been reduced only to the heating season, because coalmine Oslomej-west is almost at the end of its operational life, and there is lack of coal. Therefore, TPP Oslomej is in an unpleasant situation in regard to the supply of coal. Hence, the prospects of MEP Oslomej are uncertain as well as due to the need for modernization of the technological process, corresponding with the type of fuel, in order to increase efficiency and effectiveness and decrease emissions of harmful gases in accordance with the European environmental standards for protection of the environment (Directive 2001/80/EC, 2001, p.19-25).

For the analysis of alternatives for fueling TPP Oslomej, four options were taken into consideration: domestic lignite, imported lignite, natural gas and imported high calorie coal. (ELEM JSC, 2014, p.9). A Feasibility Study was made for the option for long-term supply of imported coal with high calorific value of 25MJ/kg (AF-Consult Switzerland Ltd. 2015, p.143). Despite all of this, no recommendations have been given yet, and no definite decision has been made regarding the option for continuing

the operation of TPP Oslomej. If none of these options is implemented, this would ultimately lead to shut down of the operation and termination of MEP Oslomej.

Conclusions

This paper is of great importance because it covers topics such as production management, human resources, price of electricity produced per generator, and activities that need to be undertaken in order to improve and increase the performance of MEP Oslomej, and accordingly the performances of ELEM. All this contributes to establishment of sustainable company competitiveness, which is still absent as a result of the regulated production capacities, and is expected to occur after full liberalization of the electricity market in the Republic of Macedonia.

In present situation, increasing the production of MEP Oslomej practically means accomplishing the planned production, on the basis of improving the efficiency and effectiveness of the plant operation, as well as timely implementation of the planned activities by the management of MEP Oslomej through the public procurement plan and the annual investment programme. In times of globalization, and as an imperative of the modern economy, this increase would have certain impact on the employment coefficient per GWh, as well as on the decrease of the price of produced electricity. Inclusively, this would create conditions, possibilities and make room for development, which is the basis for reconstruction, revitalization and modernization, contributing to the decrease of the import dependency of the country and the trade deficit, creation of sustainable company competitiveness, economic development of the entire domestic economy, macroeconomic stability of the country and at the same time getting closer to the European Union.

MEP Oslomej's management should seriously make an effort and commit through ELEM to lobby in the Government of the Republic of Macedonia to adopt a final decision on the modernization of the plant and appropriate supply of the needed quantity and quality of coal (lignite or high calorie coal) or natural gas. This is their top priority and their principal task as well with the aim of extending the operational life of TPP Oslomej, which is of great importance for the electric energy system as a whole as well as for the economic development of the municipality, the region and the entire country, including the employment of the people.

In the context of human resources management, which is one of the key factors for the company's success, it is about time for ELEM JSC, and MEP Oslomej particularly, to start implementing the programme for voluntary termination of employment, to employ new young and competent cadres, especially engineers, which number constantly decreases, and who are the main pillars of the technological process, and who would contribute to an increase of the efficiency and effectiveness of the production process, without increasing the number of employees. As opposed to this, due to the numerous unproductive politically driven employments, which is practiced nowadays, the number of employees increases enormously, which leads to increased expenditures and unacceptable electricity production from an economic perspective, thus jeopardizing the market position, competitiveness and possible privatization of the company. It is also about time for the systematization of the job

positions to correctly define the education level in line with the Bologna Process (ECTS) and proper task description for many work positions, enabling "the right people for the right job". Furthermore, MEP Oslomej should operate under the management of one General Manager, despite the legal possibility of having two general managers in ELEM's subsidiaries, since having two GMs is not practical and impedes the operation and decision-making process, which is very much visible from the end results of the plant.

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