THE IMPROVEMENT OF PEAK AND OFF-PEAK TARIFF RELATION IN POWER SALE AND ECONOMIC EFFECTS ESTIMATE

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INTRODUCTION

In most parts of the power supply system of Serbia, the relation of bought power in peak and off-peak tariffs does not correspond to the relation of sold power in peak and off-peak tariffs.
The incongruity between these relations is not in the interest of the power supply company.
The reasons of this incongruity are a system deficiency of classic variable-rate meters, the inability to timely prevent the deficiencies, and sometimes even the customers' deliberate tampering with meters.
It is impossible to exactly determine the incongruity of the analysed relation due to the tariff-groups with single-tariff electricity meters; therefore this paper contains the assumptions about the registered power distribution on the spent power in peak and off-peak tariffs.

DISTRIBUTION OF SOLD POWER

In 2005, the relation of the total amount of received active power in peak (VT) and off-peak (NT) tariff is: $W_{VT} / W_{NT} = 70.82\% / 29.18\%$. The data on distribution of active power on tariff groups in 2005 are shown in table 1.

	Peak tariff [kWh]	Off-peak tariff [kWh]	Relation VT/NT	Single-tariff consumption [kWh]
Tg2	577.657,47	207.777,83	2,78	0
Tg3	71.264.186,50	33.274.269,79	2,14	0
Tg4	39.396.069,34	17.337.014,75	2,27	0
Tg5	6.264.743,92	4.130.736,21	1,52	30.658.878
Tg6	737,40	2.051,89	0,36	7.240.379
Tg7	139.060.431,85	120.313.626,63	1,16	133.179.499
Tg8	7.183,77	4.363,48	1,65	98.139
Tg11	140.446,84	69.138,16	2,03	4.348.158
Suma	**256.711.457**	**175.338.978**	**1.46**	**175.525.054**

TABLE 1. - Distribution of active power on tariff groups in 2005

Where:

Tg 2 High voltage 35 kV

Tg 3 High voltage 1-20 kV

Tg 4 the remaining consumption at 0.4 kV – 1st tariff degree

Tg 5 the remaining consumption at 0.4 kV – 2nd tariff degree

Tg 6 Public lighting

Tg 7 Households

Tg 8 2nd tariff degree according to the household price

Tg 11 Public consumption

In the Tg 7 tariff group, the greatest consumption is the single-tariff consumption. There are 54,112 consumers with double-tariff meters in this group (55.53%) and 43,324 consumers with single-tariff meters (44.47%).
Single-tariff customers are mostly located in the rural area of this destination.
It is obvious from the Table 1 that the relation of sold power in peak and off-peak tariffs with most negative effects is in Tg 7, where it amounts to 1.16.
Customers with the electricity meters unable to register spent power according to different tariffs, have no motive, in accordance with their biological clock, to conduct the activities related to power usage at night in the off-peak period.
The amount of sold power is split on single-tariff customers according to the following relation:

$$W_{JT} = K_{Jvt} \cdot W_{JT} + K_{Jnt} \cdot W_{JT} \quad (1)$$

Where:

K_{Jvt} - supposed power participation in the peak tariff of single-tariff customers

K_{Jnt} - supposed power participation in the off-peak tariff of single-tariff customers

It is not the authors' intention to form the model for exact determining the coefficient of relation (1) in this paper. We suggest the coefficients shown in the Table 2 which determine the optimistic, the medium and the pessimistic option.

K_{Jvt} (1)	K_{Jnt} (1)	$(W_{VT}+W_{Jvt})/(W_{NT}+W_{Jvt})$ u prodaji (%/%)	W_{VT}/W_{NT} u nabavci (%/%)	Varijanta
0,9	0,1	68,24/31,76	70,82/29,18	Optimistična
0,8	0,2	65,35/34,65	70,82/29,18	Srednja
0,7	0,3	62,46/37,54	70,82/29,18	Pesimistična

TABLE 2. - Supposed incongruity in the peak and off-peak tariff relation in sale and purchase

THE ESTIMATE OF ECONOMIC EFFECT AS THE RESULT OF PEAK AND OFF-PEAK TARIFF IMPROVEMENT

The general relation of economic effect in (EU) is derived by transferring n (%) of the sold power from the off-peak to the peak tariff observing the household tariff group.
The registered energy for double-tariff customers is:

$$W_{uk} = \sum_{i=1}^{2}\sum_{j=1}^{3} W_{ij} \tag{2}$$

Where:

i – tariff label (*i* = 1 VT, *i* = 2 NT)

j – tariff zone label (*j* = 1 green, *j* = 2 blue, *j* = 3 red)

Cash value of the sold power is:

$$C_1 = W_{uk} \cdot \sum_{i=1}^{2}\sum_{j=1}^{3} \delta_{ij} \cdot K_{ij} \tag{3}$$

Where:

$\delta_{ij} = \dfrac{W_{ij}}{W_{uk}}$ - the relative value of spent power in i-tariff and j-tariff zone.

K_{ij} - the price of kWh in i-tariff and j-tariff zone.

The cash value that would be obtained by transferring n (%) consumption from the off-peak to the peak tariff amounts to:

$$C_2 = (1+n) \cdot \sum_{j=1}^{3} W_{1j} \cdot K_{1j} + (1-n) \cdot \sum_{j=1}^{3} W_{2j} \cdot K_{2j} \tag{4}$$

The total profit due to the transfer of the part of consumption from the off-peak to the peak tariff is:

$$\Delta C_2 = C_2 - C_1 = W_{uk} \cdot n \cdot \sum_{i=1}^{2} \sum_{j=1}^{3} (-1)^{i-1} \cdot K_{ij} \cdot \delta_{ij} \quad (5)$$

ΔC for a year according to the optimistic (n = 2.58%), medium (*n* = 5.47%) and pessimistic option (*n* = 8.36%) are 173,874 EU, 386,837 EU and 564,756 EU respectively.

Taking into consideration the ΔC spectrum of values, at the beginning of 2003, the Leskovac Branch Office of Power Supply Company started applying the RTK system in its consumption area. The RTK system consists of the following parts: Central Emission Site (CES), Peripheral Emission Site (PES) and the RTK receivers. The control-monitoring centres and central emission sites are located in the Management building of the "Leskovac Power Distribution Company" and in the Management building of the Surdulica Facility. The facilities of Lebane and Vlasotince, which are constituent parts of the "Leskovac Power Supply Company", do not have implemented CEM. They use tele-commanding messages emitted by the transmitter in Leskovac, which they re-emit using PEM in their areas, thus activating the function of controlling RTK receivers tariffs.

In the same period, 700 RTK receivers were installed, which included 1,940 customers (which represents 3.585% of the number of double-tariff customers). The total cash value of this investment is 128,357 EU.

In the same period, the control and setting of 9,650 variable-rate meters was conducted, which produced costs of 21,630 EU.

As a result of investing in RTK system development and controlling the existing variable-rate meters, the quotient of the registered power in peak and off-peak tariffs increased from 0.85 [1] which was the value in 2003 to $W_{VT} / W_{NT} = 1.16$ in 2005.

CONCLUSION

The correct analysis of the W_{VT} / W_{NT} relation in purchase and sale implies as accurate as possible division of single-tariff customers' consumption on the parts spent in peak and off-peak tariffs. Only then can one approximately estimate pecuniary loss of the power supply company due to the irregular functioning of double-tariff customers' variable-rate meters.

Anyway, until remote-controlled and remote-managed electricity meters have been installed, the system of remote control of the existing meters tariffs as well as monitoring and control of the existing variable-rate meters are certainly worthwhile.

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