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LOAD CURVES CHARACTERISTICS OF CONSUMERS SUPPLIED FROM ELECTRICITY REPARTITION AND DISTRIBUTION PUBLIC SYSTEMS

BY

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Abstract. Today, in our country, the profound changes affecting the operation of power systems and electricity market development, coupled with consumption shifting from high voltage (HV) to medium voltage (MV) and low voltage (LV) have raised the problem of electricity repartition and distribution system (ERDS) development and restructuring. The basic informations required for ERDS design and operation are: know-ledge of actual consumption level of household and tertiary consumers and also their forecasted energy and power demand for a shorter or longer period. Also of same degree of importance are the hourly, daily and seasonal consumption patterns within the year. Given the aforementioned considerations, the paper presents results from a measurement recording campaign of daily load curves of consumers of these systems, for determining load profiles, for chosen characteristic days from a year. Also using a software application characteristics and dimensionless parameters of the daily load curves are computed.

Keywords: load forecast; standard day; load type.

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1. Introduction

In our country with the shifting of electricity consumption from HV to MV and LV, ERDS development and restructuring of existing facilities has became of main importance. For these reasons, given the increasing technical and economical demands and restrictions to which are subjected, ERDS, require a thorough analysis of their structure and characteristics.

Because of the social and economic importance of a normal and efficient supply of all consumers and of the increasingly high number of needed operational decisions a more rigorous and coherent policy regarding development and restructuring of existing facilities is required. Also, for a rational and economically efficient operation, time and geographical coherence must be considered. At the same time in the design process of an ERDS the following aspects must be considered: type of equipments to be used in the systems and a thorough assessment of used system configuration. The mentioned aspects mean choosing of appropriate equipments and their spatial configuration – structural problems, and time configuration – strategy problems (Albert *et al.*, 1997; Eremia *et al.*, 2006; Georgescu, 2007; Ionescu *et al.*, 1998; Poeată *et al.*, 1987).

For achieving economic operational efficiency compromises must be made between short-term and long-term options, between investment costs and supply interruption costs, or between different geographical locations, etc. This process means in fact network design, a difficult task for ERDS, because of their specific features: continuous development, high number of available operational configurations and required decisions, fault diversity, working deadlines, etc.

2. Level and Structure of Electricity Consumption in Public Repartition and Distribution Systems

One of the decisive factors for choosing the right power supply solution for a certain area is the accurate knowledge of the actual consumption level, its evolution or dynamics in time, and of the main characteristic parameters of the electricity consumption, global or by different consumer categories (Codiasse *et al.*, 2001; Eremia *et al.*, 2006; Georgescu *et al.*, 2001; Ionescu, 1985). ERDS are supplying different categories of consumers – household and tertiary consumers (commercial, social-cultural, public utility, small enterprises, etc.) – each of them with lower or higher weight in the whole consumption of the studied area.

The household and tertiary consumption are two facets of electricity consumption directly by people. Their level and structure provide extensive information on the degree of social development at one moment. It should be noted that in the analysis of electricity consumption in a certain area it is necessary to determine not only the level achieved in various stages, but also the consumption patterns of the consumers, as well as the weight of various categories of receivers on the total load (Albert *et al*., 1975; Georgescu *et al*., 1997; Georgescu, 2007; Ionescu, 1998).

Classical statistical-probabilistic methods were often used before and they are also currently used to compute characteristic parameters of load curves, to determine load profiles for different types of consumers, building load type profiles databases, etc. This represents an essential information in ERDS design and operation. Also, the changes in the electricity industry and development of the electricity market raised the problem of developing topical modules which would enable all consumer categories to enter the market. These modules are of key importance, especially for household and tertiary consumers which represents the majority inside an electricity company and for which, the current procedure give information regarding only the maximum load and energy consumption, without any indication how that energy is consumed in an hour, day and season over a year (Georgescu *et al*., 1989; Poeată *et al*., 1985)

Alternatives to the aforementioned classic methods are using Artificial Intelligence (AI), with its hybrid techniques – Artificial Neural Networks (ANN), Fuzzy Logic (FL), Genetic Algorithms (GA), Evolutionary Strategies (ES) – or using load profiling models based on clustering techniques, which lead to very good results in determining typical load profiles, segmentation and sampling for the consumers categories, and in finding the optimal configuration of MV and LV distribution networks, contingency analysis in electrical networks, voltage stability estimation, etc. (Georgescu, 2007; Scutariu *et al*., 2001).

3. The Main Characteristic and Dimensionless Parameters Characterizing the Load Curves of Different Consumer Categories

Loads and load curves characteristics are essential for solving technical and economical high complexity problems in ERDS optimal design and operation when supplying different consumer categories. The load curve or diagram of a consumer or facility indicates the variation in time of the load and it is described by certain characteristics or parameters, which reproduce the steady-state of the supplied receivers.

To evaluate the load level and main characteristics and dimensionless parameters of the load curves, in urban and rural public distribution networks, several measurement campaigns (load curves recordings) were carried out at different characteristic points – LV household and tertiary distribution cabinets, LV and MV substation bus bars, etc. – for different consumer categories. At the same time, data sampling were performed and the results were reported in type questionnaires. These campaigns were carried out periodically to establish the load level and pattern in time, in public distribution networks, at different times of the year; at national and regional level (Georgescu *et al*., 1983; Georgescu *et* *al*., 1997; Georgescu *et al*., 2001; Ionescu *et al*., 1985; Ionescu *et al*., 1998; Poeată *et al*., 1985; Poeată *et al*., 1987; Scutariu *et al*., 2001).

After modernizing the regional electricity distribution companies with new and advanced measuring equipments, such measurement campaigns were carried out recently, during 1999…2003 and 2009…2010 years, respectively. For this analysis, the active and reactive load curves were recorded in different ERDS key points: MV bus bars in 110/20 kV substation; MV feeders in HV/MV substations; MV and LV bus bars in 20/0.4 kV substations; LV feeders in MV/LV substations, LV household distribution cabinets, etc. The analysed HV/MV substations were of mixed type supplying urban and rural household, tertiary or industrial consumers. MV/LV substations are of network or individual type. The network type substations were urban and rural with various household and tertiary consumptions.

In the 2009…2010 campaign the load curves were recorded for each month of the year, for standard days (ANRE, 2000; ANRE, 2002). The SCADA system (Supervisory Control and Data Acquisition) or ALPHA three phase electronic meters with a sampling rate of 5 or 15 min were used, and the energy consumption was computed by integrating the load curves (Georgescu, 2007). In addition, the aforementioned metering devices allowed tracking the evolution of some parameters that describe the load curves, achieving, at the same time, useful information regarding the distorting state occurring inevitably in these networks, and the evolution of characteristic parameters of the current and voltage waveforms. Data were recorded continuously on a 30 day's period of a month of the year, estimated to be sufficient for this analysis. All the data was acquired using a notebook computers and Power Quality Inspector (PQM) software connected to the ALPHA meters (Georgescu *et al*., 2001; Georgescu, 2007; ANRE, 2000; ANRE, 2002; ANRE, 2007).

It is important to note that each quantity must be coupled with a time interval for which the measurements were taken: 1 to 10 sec and 15, 30, 60 min. By the criterion of load interval, two categories can be distinguished:

a) Continuous load (15, 30 or 60 min), which is necessary for rational choosing and sizing of the components using technical limitation such as voltage drops or power and energy losses, etc.

b) Short-time load or peak load (1 to 10 sec), used for computing voltage fluctuations, for choosing appropriate protection and automation devices, for checking voltage drops in special circumstances, etc.

Using a software application, daily load curves recorded at various key points in the systems, for different period of the year, were automatically processed as 24 hourly values series, each hourly value representing the average hourly load of the curve. Using also the additional data obtained after the data samplings concomitantly with measurements, a number of characteristics and dimensionless parameters for the processed load curves, for continuous load, were established, such as: the maximum load, the minimum load, the average load, mean square load, peak load time and load factor, losses time and loss factor, dispersion, standard deviation, the fill factor of the load curve, irregularity and shape coefficient of the load curve, the correlation coefficient between the active and reactive loads, etc.

The expressions for the above mentioned parameters, for continuous load, which have been used in software application development, are the following:

a) Minimum load:

$$X_{\min} = \min\left\{X(t); t \in \left(0, T_f\right)\right\}.$$

b) Average load:

$$X_{\text{med}} = \frac{1}{T_f}\int_0^{T_f} X(t)\mathrm{d}t = \frac{\sum_{k=1}^{N_T} X_k \Delta t_k}{\sum_{k=1}^{N_T} \Delta t_k}.$$

c) Mean square load:

$$X_{\text{m.p.}} = \sqrt{\frac{\int_0^{T_f} X^2(t)\mathrm{d}t}{T_f}} = \sqrt{\frac{\sum_{k=1}^{N_T} X_k^2 \Delta t_k}{\sum_{k=1}^{N_T} \Delta t_k}}.$$

d) Maximum load:

$$X_{\max} = \max\left\{X(t); t \in \left(0, T_f\right)\right\}.$$

e) Maximum load time:

$$T_{\max_X} = \frac{1}{X_{\max}}\int_0^{T_f} X(t)\mathrm{d}t = \frac{\sum_{k=1}^{N_T} X_k \Delta t_k}{X_{\max}}.$$

f) Load factor:

$$T_{\max}^{*} = \frac{1}{T_f X_{\max}} \int_{0}^{T_f} X(t)\mathrm{d}t = \frac{\sum_{k=1}^{N_T} X_k \Delta t_k}{X_{\max} \sum_{k=1}^{N_T} \Delta t_k}.$$

g) Losses time:

$$\tau_X = \frac{1}{X_{\max}^2} \int_{0}^{T_f} X^2(t)\mathrm{d}t = \frac{\sum_{k=1}^{N_T} X_k^2 \Delta t_k}{X_{\max}^2}.$$

h) Losses factor:

$$\tau_X^{*} = \frac{1}{T_f X_{\max}^2} \int_{0}^{T_f} X^2(t)\mathrm{d}t = \frac{\sum_{k=1}^{N_T} X_k^2 \Delta t_k}{X_{\max}^2 \sum_{k=1}^{N_T} \Delta t_k}.$$

i) Load dispersion:

$$\sigma_X^2 = \frac{1}{T_f} \int_{0}^{T_f} X^2(t)\mathrm{d}t - \left(\frac{1}{T_f} \int_{0}^{T_f} X(t)\mathrm{d}t \right)^2 = X_{\text{m.p.}}^2 - X_{\text{med}}^2 .$$

j) Standard deviation:

$$\sigma_X = \sqrt{X_{\text{m.p.}}^2 - X_{\text{med}}^2} .$$

k) Variation coefficient:

$$k_{v_X} = \frac{\sigma_X}{X_{\text{med}}}.$$

l) Irregularity coefficient of load curve:

$$\alpha_X = \frac{X_{\min}}{X_{\max}}.$$

m) Fill factor of load curve:

$$k_{u_X} = \frac{X_{\text{med}}}{X_{\max}}.$$

n) Shape coefficient of load curve:

$$k_{F_X} = \frac{X_{\text{m.p.}}}{X_{\text{med}}}.$$

o) Correlation coefficient between X and Y:

$$r_{XY} = \frac{1}{T_f}\int_0^{T_f} X(t)Y(t)\mathrm{d}t - \frac{X_{\text{med}}Y_{\text{med}}}{\sigma_X\sigma_Y}.$$

p) Weighted power factor by active load:

$$\cos\varphi_{\text{pond}}\left(\text{tg}\varphi_{\text{pond}}\right).$$

q) Loading coefficient of the transformers from HV and MV substation at average load and peak load:

$$k_{m_X} = \frac{X_{\text{med}}}{S_n};\ \ k_{M_X} = \frac{X_{\max}}{S_n}.$$

The software application allows, in a similar way, the computing of characteristics and dimensionless parameters that describe the load curves for short-term load or peak load, depending on the user choice and needed data.

4. Case Studies and Obtained Results

Considering that, in the recent years, the household consumers are increasingly endowment with modern electrical equipments, and because of the fact that the tertiary consumers load pattern has changed, other determining factors for consumer load curves are daily temperature variations and natural daylights hours.

A summary of the results obtained using the previously described methodology and software application based on the data acquired during the 2009…2010 years study is presented in what follows.

First, active and reactive load curves for household and tertiary consumption at MV busbars from stations were recorded and analysed. These substations are located in two cities, one with a population of about 50,000 inhabitants and the second, with over 500,000 inhabitants. Both stations are of mixed type, supplying household, tertiary and industrial consumers.

It should be noted that for analysis from both stations, only the household and tertiary consumption was retained, which has a significant weight (0.90…0.92) in the total consumption, eliminating MV busbars which feeds industrial consumers and have a reduced weight in the total consumption and a random daily behaviour.

The first substation (ST1) is equipped with two identical 110/20 kV transformers (S_n = 25 MVA), and MV single sectionalized busbar with closed circuit breaker in normal operation. A single transformer is in operation, the other being a backup. The ST1 substation has twelve MV feeders, seven undergrounds and five overheads.

The second 110 kV/MV substation (ST2) is equipped with an 110/20 kV transformer (S_{n} = 25 MVA), and with an 110/6 kV (S_{n} = 16 MVA), with different MV busbars systems – MV single sectionalized busbar type with closed circuit breaker in normal operation. The ST2 substation has seven feeders of 20 kV and six feeders of 6 kV. In the same manner, single feeder consumptions from both substations, with different weights in terms of household and tertiary consumption, were analysed.

a

b

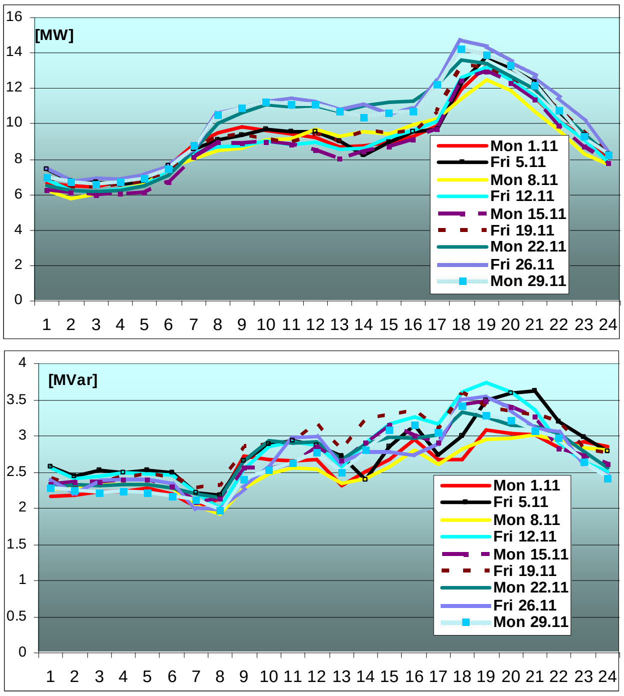

Fig. 1 – Active (*a*) and reactive (*b*) load curves for Monday and Friday of ST1.

a

b

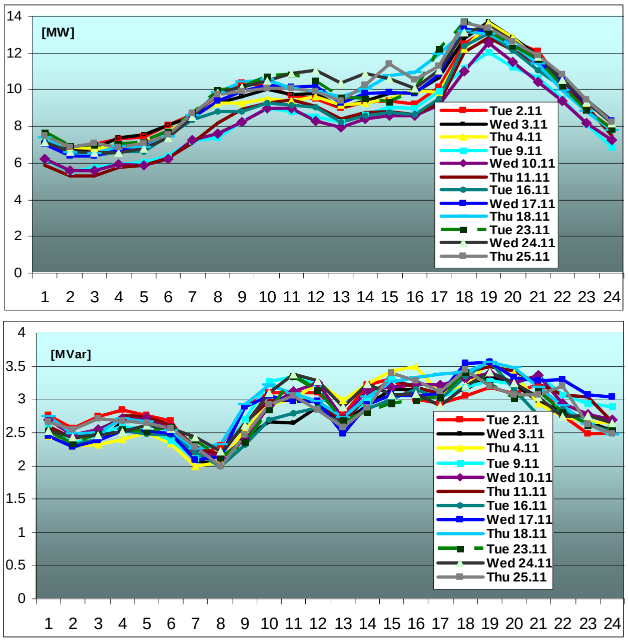

Fig. 2 – Active (*a*) and reactive (*b*) load curves for Tuesday, Wednesday and Thursday of ST1.

a

b

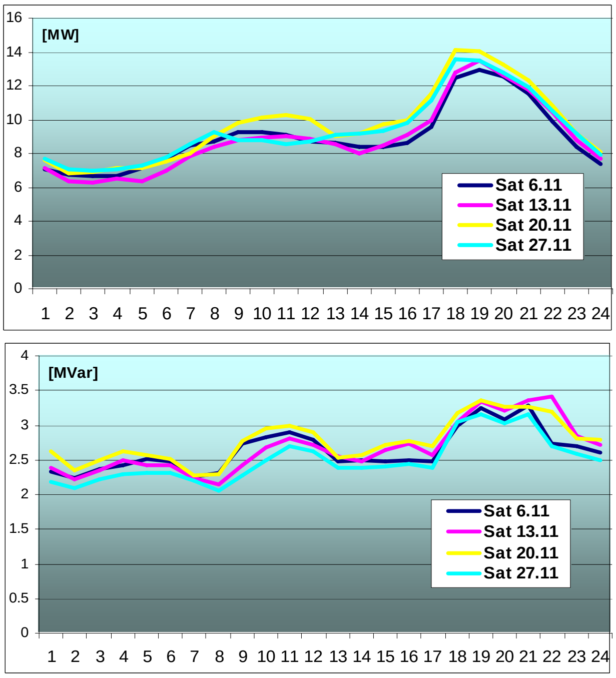

Fig. 3 – Active (*a*) and reactive (*b*) load curves for Saturday of ST1.

a

b

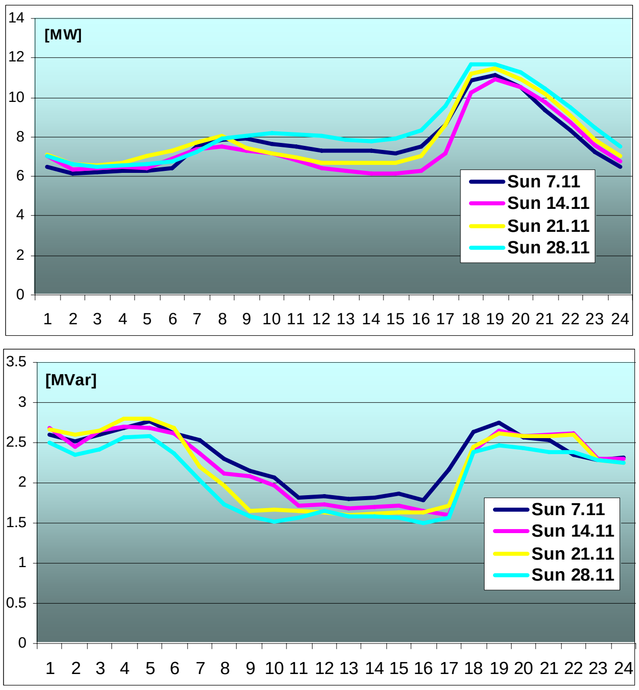

Fig. 4 – Active (*a*) and reactive (*b*) load curves for Sunday of ST1.

a

b

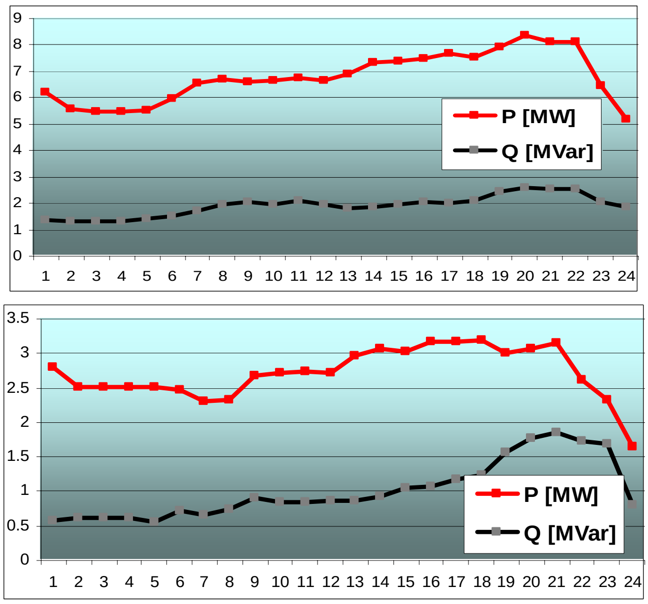

Fig. 5 – Active and reactive load curves for Tuesday, Wednesday and Thursday at 6 kV (*a*) and 20 kV (*b*) from ST2.

a

b

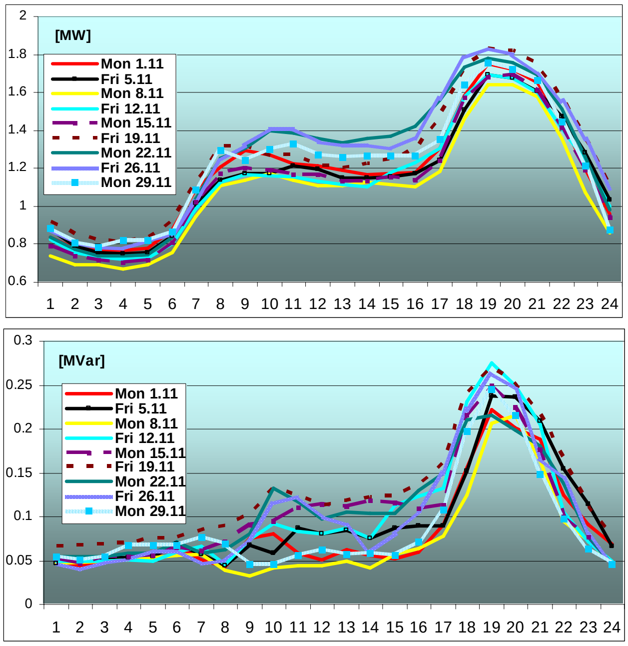

Fig. 6 – Active (*a*) and reactive (*b*) load curves for Monday and Friday of ST1 feeder.

a

b

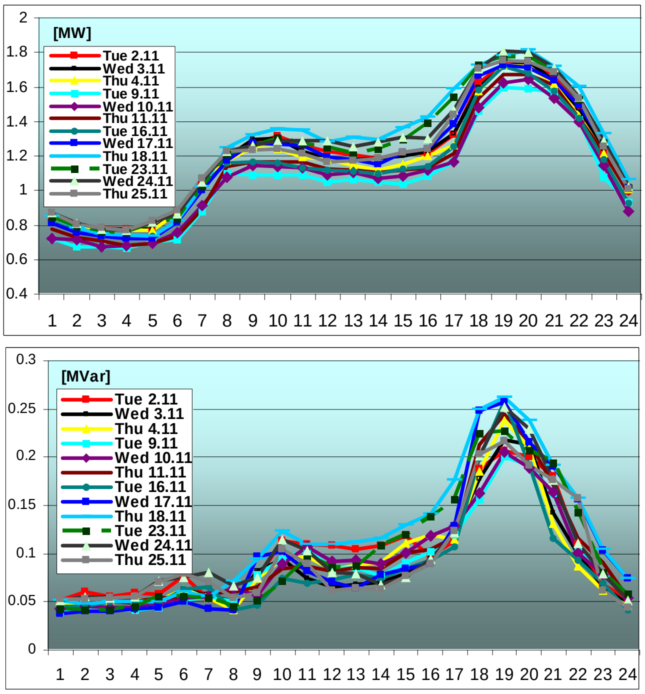

Fig.7 – Active (*a*) and reactive (*b*) load curves for Tuesday, Wednesday and Thursday of ST1 feeder.

a

b

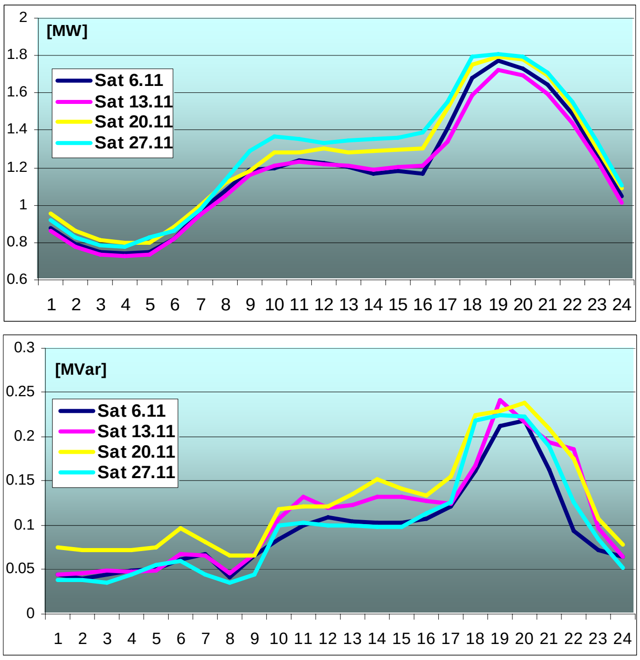

Fig. 8 – Active (*a*) and reactive (*b*) load curves for Saturday of ST1 feeder.

a

b

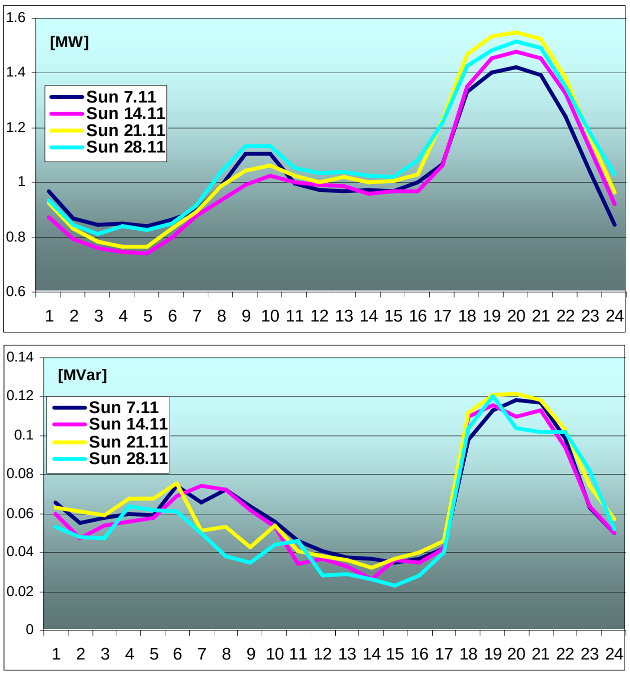

Fig. 9 – Active (*a*) and reactive (*b*) load curves for Sunday of ST1 feeder.

Table 1
Main Characteristics and Dimensionless Parameters of Load Curves for ST 1 and ST 2, in Standard Days

Parameters	Standard day					
	ST1				ST2	
	Mon-Fri	Tue-Wed-Thu	Saturday	Sunday	Tue-Wed-Thu 20kV	Tue-Wed-Thu 6 kV
$P_{\min}$; $P_{\max}$, [MW]	6.338; 13.54	6.395; 13.23	6.703; 13.50	6.327; 11.32	1.600; 3.200	2.300; 8.300
P_{med}, [MW]	9.396	9.249	9.205	7.841	2.717	5.750
$Q_{\min}$; $Q_{\max}$, [MVar]	2.067; 3.440	2.096; 3.451	2.177; 3.311	1.626; 2.717	0.600; 1.900	0.700; 2.600
Q_{med}, [MVar]	2.714	2.675	2.675	2.196	1.013	1.621
$S_{\min}$; $S_{\max}$, [MVA]	6.752; 13.96	6.834; 13.67	7.088; 13.89	6.700; 11.62	1.789; 3.636	2.404; 8.698
S_{med}, [MVA]	9.788	9.674	9.592	8.159	2.920	5.977
$P_{\mathrm{m.p}}$, [MW]	92.796	89.474	88.705	63.773	7.523	37.265
$Q_{\mathrm{m.p}}$, [MVar]	7.530	7.995	7.288	4.993	1.196	3.002
$S_{\mathrm{m.p}}$, [MVA]	100.326	97.470	95.993	68.766	8.720	40.267
$T_{\max P}$; $T^*_{\max P}$, [h]	16.66; 0.694	16.77; 0.699	16.36; 0.682	16.62; 0.692	20.37; 0.849	16.63; 0.693
$T_{\max Q}$; $T^*_{\max Q}$, [h]	18.98; 0.791	19.38; 0.812	19.38; 0.808	19.40; 0.808	12.79; 0.533	14.96; 0.623
$T_{\max S}$; $T^*_{\max S}$, [h]	16.83; 0.701	16.98; 0.708	16.57; 0.691	16.85; 0.702	19.28; 0.803	16.49; 0.687
$\tau_{\max P}$; $\tau^*_{\max P}$, [h]	12.12; 0.505	12.23; 0.509	11.67; 0.486	11.92; 0.497	17.63; 0.735	12.98; 0.541
$\tau_{\max Q}$; $\tau^*_{\max Q}$, [h]	15.33; 0.639	16.12; 0.672	15.91; 0.663	16.22; 0.676	7.95; 0.331	10.66; 0.444
$\tau_{\max S}$; $\tau^*_{\max S}$, [h]	12.32; 0.513	12.49; 0.521	11.93; 0.497	12.21; 0.509	15.83; 0.660	12.77; 0.532
$\cos\varphi_{\max}$; $\cos\varphi_{\min}$	0.969; 0.939	0.968; 0.935	0.972; 0.945	0.974; 0.945	0.880; 0.894	0.954; 0.957
$\cos\varphi_{\mathrm{pond}}$	0.960	0.956	0.960	0.961	0.933	0.962
σ_P; σ_P^2	2.046; 4.225	1.908; 3.651	1.964; 3.873	1.481; 2.197	0.378; 0.143	2.050; 4.202
σ_Q; σ_Q^2	0.389; 0.153	0.364; 0.134	0.331; 0.111	0.401; 0.162	0.414; 0.171	0.612; 0.375
σ_S; σ_S^2	2.053; 4.252	1.903; 3.632	1.965; 3.876	1.454; 2.118	0.436; 0.190	2.131; 4.543
k_{v_P}	0.217	0.207	0.213	0.189	0.139	0.357
k_{v_Q}	0.143	0.130	0.124	0.183	0.409	0.378
k_{v_S}	0.209	0.197	0.205	0.178	0.149	0.357
r_{PQ}	0.809	0.741	0.830	0.255	0.385	0.947
α_P	0.468	0.483	0.497	0.559	0.500	0.277
α_Q	0.603	0.608	0.658	0.598	0.316	0.269
α_S	0.484	0.500	0.511	0.576	0.492	0.276
k_{u_P}	0.694	0.699	0.682	0.692	0.849	0.693
k_{u_Q}	0.791	0.812	0.808	0.808	0.533	0.623
k_{u_S}	0.701	0.708	0.691	0.702	0.803	0.687
k_{F_P}	9.843	9.645	9.625	8.121	2.769	6.481
k_{F_Q}	2.770	2.849	2.716	2.270	1.181	1.852
k_{F_S}	10.220	10.050	9.996	8.418	2.986	6.737
k_{m_P}; k_{M_P}	0.376; 0.541	0.370; 0.529	0.368; 0.540	0.314; 0.453	0.109; 0.128	0.230; 0.332
k_{m_Q}; k_{M_Q}	0.109; 0.138	0.112;0.138	0.107; 0.132	0.088; 0.109	0.041; 0.076	0.065; 0.104
k_{m_S}; k_{M_S}	0.392; 0.558	0.387; 0.547	0.384; 0.556	0.326; 0.465	0.117; 0.145	0.239; 0.348

Table 2

Main Characteristics and Dimensionless Indicators of Load Curves for ST 1 and ST 2 Feeders, in Standard Days.

Parameters	20 kV feeders of ST1				20 kV feeders of ST2			
	Mon-Fri	Tue-Wed-Thu	Saturday	Sunday	Mon-Fri	Tue-Wed-Thu	Saturday	Sunday
$P_{\min}$; $P_{\max}$, [MW]	0.748; 1.731	0.720; 1.686	0.759; 1.777	0.790; 1.47	0.431;0.882	0.436;0.899	0.403;0.802	0.403;0.725
P_{med}, [MW]	1.171	1.145	1.217	1.041	0.662	0.687	0.601	0.533
$Q_{\min}$;$Q_{\max}$, [MVar]	0.046; 0.242	0.041; 0.223	0.046; 0.231	0.029; 0.12	0.004; 0.129	0.009;0.139	0.003;0.096	0.001;0.060
Q_{med}, [MVar]	0.096	0.091	0.107	0.059	0.054	0.060	0.039	0.017
$S_{\min}$;$S_{\max}$, [MVA]	0.751; 1.747	0.721; 1.700	0.761; 1.791	0.792; 1.47	0.431; 0.891	0.437;0.909	0.403;0.808	0.403;0.728
S_{med}, [MVA]	1.175	1.149	1.222	1.043	0.665	0.691	0.603	0.534
$P_{m.p}$, [MW]	1.463	1.408	1.578	1.124	0.463	0.507	0.377	0.294
$Q_{\text{m.p}}$, [MVar]	0.012	0.011	0.015	0.004	0.004	0.006	0.002	0.001
$S_{\text{m.p}}$, [MVA]	1.475	1.419	1.593	1.129	0.467	0.513	0.791	0.294
$T_{\max P}$; $T^*_{\max P}$, [h]	16.23; 0.676	16.28; 0.678	16.43; 0.685	17.04;0.710	18.00; 0.750	18.35;0.764	18.01;0.750	17.66;0.736
$T_{\max Q}$; $T^*_{\max Q}$, [h]	9.546; 0.398	9.717; 0.405	11.17; 0.465	12.18;0.507	10.11; 0.421	10.24;0.427	9.725;0.405	6.877;0.287
$T_{\max S}$; $T^*_{\max S}$, [h]	16.14; 0.672	16.20;0.675	16.37; 0.682	17.02;0.709	17.906;0.746	18.23;0.760	17.93;0.747	17.62;0.734
$\tau_{\max P}$; $\tau^*_{\max P}$, [h]	11.69; 0.487	11.78; 0.491	11.98; 0.499	12.54;0.523	14.23; 0.746	14.72;0.613	14.05;0.585	13.41;0.559
$\tau_{\max Q}$; $\tau^*_{\max Q}$, [h]	5.093; 0.212	5.335; 0.222	6.610; 0.275	7.371;0.307	6.377; 0.268	6.274;0.261	6.010;0.250	4.436;0.185
$\tau_{\max S}$; $\tau^*_{\max S}$, [h]	11.56; 0.482	11.68; 0.487	11.90; 0.496	12.51;0.521	14.09; 0.266	14.55;0.606	13.94;0.581	13.35;0.556
$\cos\varphi_{\max}$; $\cos\varphi_{\min}$	0.990; 0.997	0.992; 0.998	0.992; 0.997	0.993;0.998	0.990; 0.998	0.989;0.999	0.993;0.999	0.997;0.999
$\cos\varphi_{\text{pond}}$	0.996	0.997	0.996	0.996	0.996	0.995	0.997	0.999
σ_P; σ_P^2	0.295; 0.087	0.294; 0.087	0.309; 0.096	0.197;0.040	0.150; 0.023	0.151;0.023	0.121;0.015	0.094;0.009
σ_Q; σ_Q^2	0.055; 0.003	0.052; 0.003	0.055; 0.003	0.025;0.001	0.036; 0.001	0.037;0.001	0.028;0.001	0.019;0.001
σ_S; σ_S^2	0.298; 0.089	0.297; 0.089	0.313; 0.098	0.197;0.040	0.152; 0.023	0.154;0.024	0.122;0.015	0.094;0.009
k_{v_P}	0.253	0.259	0.256	0.189	0.229	0.224	0.202	0.176
k_{v_Q}	0.251	0.257	0.254	0.188	0.227	0.221	0.200	0.175
k_{v_S}	0.578	0.595	0.519	0.420	0.706	0.660	0.728	1.101
r_{PQ}	0.862	0.881	0.920	0.585	0.911	0.924	0.881	0.714
α_P	0.432	0.426	0.427	0.540	0.489	0.484	0.503	0.556
α_Q	0.189	0.178	0.200	0.251	0.030	0.048	0.029	0.015
α_S	0.429	0.424	0.425	0.540	0.484	0.479	0.500	0.554
k_{u_P}	0.676	0.678	0.685	0.710	0.750	0.764	0.750	0.736
k_{u_Q}	0.398	0.405	0.465	0.507	0.421	0.427	0.405	0.287
k_{u_S}	0.672	0.675	0.682	0.709	0.746	0.760	0.747	0.734
k_{F_P}	1.245	1.220	1.295	1.080	0.696	0.721	0.625	0.550
k_{F_Q}	0.128	0.121	0.136	0.069	0.080	0.085	0.059	0.038
k_{F_S}	1.251	1.225	1.302	1.082	0.700	0.725	0.628	0.551
k_{m_P}; k_{M_P}	0.047;0.069	0.046; 0.067	0.049; 0.071	0.042;0.059	0.026; 0.035	0.027;0.036	0.024;0.032	0.021;0.029
k_{m_Q}; k_{M_Q}	0.004; 0.010	0.004; 0.009	0.004; 0.009	0.002;0.005	0.002; 0.005	0.002;0.006	0.002;0.004	0.001;0.002
k_{m_S}; k_{M_S}	0.047; 0.070	0.046; 0.068	0.049;0.072	0.042;0.059	0.027; 0.036	0.028;0.036	0.024;0.032	0.021;0.029

A prime goal of recorded daily load curves analysis was to check allure or profile of these curves within the meaning of their similarity during a year, in two variants namely: considering the cold (winter) and warm (summer) season for working and rest days or considering the standard days of each month. After determining the correlation coefficients between active and reactive loads daily changes in the two mentioned variants, there was, without doubt, the standard days version for each month provides the best results. This can be easily observed also from visual analysis of daily load curves represented in Figs. 1…4 for the ST1 and Fig. 5 for ST2. It should also be noted that similar results were obtained for a series of feeders from both stations, partially presented in Figs. 6…9.

Another goal of the present study was to determine for each curves recorded the characteristics and dimensionless parameters. The obtained results are summarized for both MV stations analysed in Tables 1 and 2 for a series of feeders with different weights.

4. Conclusions

In last years, the profound changes in the electricity market developments in our country, accompanied by the shifting of electricity consumption from HV to MV and LV brought to the present problem of optimal development and restructuring of repartition and distribution systems. Given the general characteristics of these systems was necessary to develop design and restructuring models for rational repartition and distribution systems and, also, their effective operation in economic and financial terms. These models are essential, especially for households and tertiary consumers of the electricity distribution regional companies and for which the monitoring process through the installation of electronic meters, as well the ways to create transmission information are economically inefficient.

In design and operation of the distribution facilities it's necessary to use the profiling techniques of loads for the consumer categories to estimate the loads and daily load curves, in standard days. In this way, the profiles or daily load curves are established by consumer categories, for continuous load in 24-hours levels, and for short-term load or peak load, when the number of levels is higher.

Following a recent campaign of measurements/recordings, during the years 2009… 2010, the paper presents, to update, some obtained results of consumer load profiles from these MV substation and feeders, for determining characteristics and dimensionless parameters which described these profiles.

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CARACTERISTICILE CURBELOR DE SARCINĂ ALE CONSUMATORILOR ALIMENTAȚI DIN SISTEMELE PUBLICE DE REPARTIȚIE ȘI DISTRIBUȚIE A ENERGIEI ELECTRICE

(Rezumat)

În prezent, schimbările profunde înregistrate în sistemul energetic, precum și evoluția pieței de energie din țara noastră, însoțite de deplasarea consumului de la înaltă spre medie și joasă tensiune au adus în actualitate dezvoltarea și restructurarea sistemelor de repartiție și distribuție a energiei electrice. Informațiile de bază necesare în vederea proiectării și exploatării corespunzătoare a acestor sisteme constau în cunoașterea cât mai exactă a nivelului actual de consum pentru consumatorii casnici și terțiari, precum și a prognozelor asupra cererii de putere sau energie pe un orizont mai apropiat sau mai îndepărtat. Totodată, la fel de important este și modul în care se consumă energia respectivă, în funcție de oră, zi, precum și sezonier, de-a lungul unui

an calendaristic. Din aceste considerente, în lucrare sunt prezentate rezultatele obținute în urma unei campanii recente de măsurători/înregistrări ale curbelor zilnice de sarcină din nodurile sistemelor respective, în scopul stabilirii formei sau profilului acestor curbe, pentru zilele caracteristice ce urmează a fi luate în considerare, pe parcursul unui an. De asemenea, prin utilizarea unui program de calcul specializat, au fost stabilite caracteristicile şi indicatorii adimensionali care caracterizează aceste curbe zilnice de sarcină.