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THE ECONOMIC USABILITY FACTOR ANALYSIS OF POWER TRANSFORMER FROM ELECTRIC ENERGY REPARTITION SYSTEMS

BY

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Abstract. From technical and economical point of view, a rational and efficient operation for electric energy repartition and distribution systems is conditioned by their ability to allow the increase of electric energy transit yield, active power and energy losses minimization, the improvement of power quality delivered to consumers, etc. Also, in the paper, the economic usability factor (EUF) at most highly loaded working day of the cold winter state for the 110 kV installations located in the N-E area from our country is analysed. Based on the supplied results can be selected the power repartition system elements (power lines and power transformers) that will be subjected to a more careful and detailed analysis in order to increase the available opportunities of the considered repartition system to achieve the pursued desiderata of each electric energy territorial repartition and distribution company.

Key words: power transformer; economic usability factor.

1. Introduction

Electric energy repartition public systems from our country are made up by overhead and cable lines with 110 kV nominal voltages, 110 kV/MV stations

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and 110 kV or MV switching substations intended for electric energy territorial repartition, and for supply of consumers that have electric energy delimitation points with supplier at these voltages. Through these systems are supplied with electric energy household and tertiary consumers, and small power industrial consumers (captive consumers), that require power supply conditions similar to tertiary consumption. Taking into account the consumption current levels, the MVA/km^2 load density and the consumption forecast for a 15…20 years perspective, the voltage of repartition networks is currently 110 kV and will develop also at this voltage. Typically, the 110 kV repartition networks operate in looped or complex looped configuration, the electric energy supply being performed from the least two different injection points bars of the power system or local power plants (Georgescu, 2007; Ionescu *et al.*, 1998; PE132, 2003).

The profound changes that occurred during the last decades both our country and globally, accompanied by the more and more efficient energy markets operation and, at the same time, the considerable shifting of the electric energy consumption from high voltage (HV) to medium (MV) and low voltage (LV) required a special attention of the specialists from the electric energy repartition and distribution systems (ERDS) complex designing, reconstruction and rational operation, from the technical and economical point of view.

Regarding the policy on power quality supplied, power and energy losses minimization, power transmission yield and the related management methods, they represent priorities for each territorial electric energy distribution and supply company. The aforementioned priorities must be harmonized with the general company development strategy, with *Quality – Environment – Health* and *Occupational Safety* integrated management system.

2. Electric Energy Repartition and Distribution System Monitoring

Both in the public ERDS design and operation stage, it is necessary to know the consumption level and the load curves for all household and tertiary consumers supplied from these systems. In time, depending on the available equipment of the territorial electricity distribution companies, for the consumed electric loads and load curves monitoring different methods are used, such as: remote control, local monitoring devices, active and reactive energy counters, electronic data acquisition systems, etc.

The electronic data acquisition systems from a certain process represents a measurement method that has strongly developed during the last decades especially due to significant and accelerated characteristics improvement of the used equipment. This has been possible as a result of the top technological achievements in the electronics area, such as data transmission through the intensive use of optic fibre circuits.

At present, most of the public repartition systems from our country are automatically monitored or in process of being monitored up to the MV bars level at the step-down stations, either by using the SCADA systems or by using the Guardian systems that include electronic Alpha three-phase counters (Poeată *et al.*, 1981; Eremia *et al.*, 2006; Georgescu *et al.*, 2010).

At the same time, the spectacular evolution of the automatic computation systems, achieving remarkable performances especially regarding the memory and data storage capacity, such an ever increasing computation speed directly influenced the mathematical models, methods and computation algorithms improvement by boosting, step by step, the implementation of real time complex processes management that occur in ERDS. In this way, a new approach conception related to analysis, development, reconstruction and optimal operation of electric energy repartition systems with the purpose of service quality improvement have outlined (Georgescu, 2007; Georgescu *et al.*, 2011).

3. The Economic Utilization Factor of Power Transformer from 110 kV/MT Step-Down Substation

A rational operating of an ERDS is conditioned, especially, by whole system capacity and its element (110 kV repartition lines, 110 kV/MV power transformers, MV feeders – 6 kV, 20 kV and LV feeders – 0.4 kV, MV/ 0.4 kV power transformers) allowing both power and energy losses minimization and the improvement of power quality delivered to consumers. These goals are tracked from the design phase, when each system element must be optimal dimensioned from technical and economical points of view.

The EUF (economic usability factor) values, as instructed in our country (Buhuş *et al*., 1991, 1993), represent the ratio of total transit load effective achieved in a given year and the transition that would be economic achieved through power transformer, power line or entire analysed system if was economical dimensioned in concrete conditions from the analysed year.

It should be noted that, over the years, the economic optimum point can be modified, when load indicators curve is modified (for example: maximum load duration) or may be significant changes in system prices both in our country and world market. These EUF values should be determined in each year, to highlight the installations with significant optimal technical and economical deviations in operation (Buhuş *et al*., 1991, 1993).

If the EUF presents significant deviations compared to 100%, further more detailed analysis must be made regarding to whether or not the optimum technical and economical for a new optimization process. As examples can be mentioned the following: the change of power transformers from substations or stations with higher or lower rated power transformers, the consumers relocation from a power line to another, the managed ERDS retrofitting and systematization, etc. Finally, based on a cost–benefit analysis, could be enforced only solutions that are expected to generate real profit.

Periodic determination of EUF must be interpreted as a necessary action in operation that aims to systematically pursue the economic health and opportunities available for public ERDS. Moreover, the EUF determination can be interpreted as a mobile or an incentive for the substations and stations endowment with strictly necessary measuring equipments for a rational operation both technical and economical point of view (Georgescu, 2007; Georgescu *et al.*, 2010; Poeată *et al.*, 1981).

In public ERDS from our country, power transformers that equip station and substations shall be deemed to have been designed from economic and technical point of view at maximum load duration ,T_S, achieved in the previous operation year. In current operation, for the power transformer annual EUF determination, the following definitions and notations are used (Buhuş *et al.*, 1991, 1993):

1° $S_{M\text{pec}}(T)$ – *maximum load for a power transformer* considered as the middle domain of maximum load corresponding to the maximum load duration, T_S, for which it is economic the choice of this power transformer type in design stage, using the "minimum total updated expenses (TUE)" criterion. In our country, the economic choice fields of power transformers are indicated both in literature and standards (regulations). When the maximum load domain for economical choice of transformers are higher than transformer rated power, the upper frontier of these domains must lowered to transformer rated power value (S_{nT}). For these cases, as maximum load, $S_{M\text{pec}}$, the middle domain will be considered taking into account the restriction on the transformer rated apparent power.

2° *EUF – economic usability factor for transit capacity of a power transformer.* This economic capacity transit is deemed to be chosen in the design phase properly of the maximum load duration, T_S , for analysed year. Thus, the power transformer usability factor can be determined with the following expressions:

$$\text{EUF} = \frac{S_M}{S_{M\,\text{pec}}\left(T_S\right)} \tag{1}$$

or

$$\text{EUF} = \frac{I_M}{I_{M\,\text{pec}}\left(T_S\right)}, \tag{2}$$

where $S_{M\text{pec}}(T_S)$ is the maximum load for a power transformer above described. The maximum load domains for different utilization durations were established using "*minimum TUE*" criteria.

3° *CPW – total updated cost of active power and energy losses* during the study period (one year), which can be determined with the following expression:

$$\text{CPW}_a = \text{CPW}_{\text{ec},a} - \text{EUF}^2. \tag{3}$$

The necessary and useful information for the economic usability factor of a power transformer are:

a) Transformer constructive data necessary for the transit capacity assessment under economic conditions, namely: transformer type, *i.e.* TTUS – FS – Al; transformer rated power. Must be noted that, for power transformers which are not known the maximum loads ($S_{M\text{pec}}$) and losses costs (CPW_{ec}), is necessary to know the own technological consumption level at nominal load, *i.e.* transformer windings nominal losses, and, if necessary, the consumption of ventilators and oil pumps used for cooling.

b) Load transit data that was accomplished by the power transformer, namely: nominal voltage that is supplied the transformer, the maximum current (I_M) for considered year, active and reactive energy transit (W_P and W_Q) and active and reactive powers (P_M and Q_M) at maximum load for maximum apparent load determination, with the relation $S_M = \sqrt{P_M^2 + Q_M^2}$. Should be noted that previous relation provides more accurate results than $S_M = \sqrt{3} U_M I_M$.

c) Load transit (W_S) and maximum total load duration (T_S). The total load transit through each public system element (power transformer) can be determined with approximations (in most cases, do not exceed 3%), using the relations $W_S = \sqrt{W_P^2 + W_Q^2}$, and maximum total load duration using the ratio $T_S = W_S / S_M$.

4. The Necessary Data for EUF Computation of Power Transformer from 110 kV/MT Step-Down Station

In the literature and actual standards, regulations and instructions from our country (Buhuş *et al.*, 1991, 1993; Ionescu *et al.*, 1998), official necessary data to computation of the EUF elements (power lines and power transformers) from public ERDS are published. Thus, in the following the EUF computation necessary data only for power transformers from 110 kV/MV step-down stations are given. All these strictly necessary data are shown in Tables 1,..,5 for all power transformers type used in electric energy repartition systems, currently existing in our country.

Should be mentioned that in public distribution systems for electric energy are specific situations where technical restrictions are more stringent than those imposed by economic criteria. Among them can be mentioned: power supply continuity ensured by additional investments for new reserve paths; thermal stability for short circuit state, such as the 20 kV cable lines where the minimum feeders cross-section from 110/20 kV stations must be at least 150 mm^2, even if would register a low value of EUF indicator (just a few percent); the minimum allowable voltage for different consumer categories supplied with electric energy from public repartition systems. For above situations and other similar cases it is necessary to calculate the EUF for all elements of the analysed system, taking into account the installed power transformers, even though some of these power transformers were kept in reserve.

Table 1

TTUS - NS-Al Transformers, Loads (S_{Mpec}) *and Losses Costs* (CPW_{ec})

S_{nT} MVA	T_S, [hours/year]								
	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	8,760
	S_{Mpec}, [MVA]								
10	8.1	7.4	6.7	6.1	5.6	5.1	4.6	4.2	4.0
16	13.0	12.5	11.4	10.4	9.5	8.6	7.9	7.2	6.7
25	20.5	21.5	19.8	19.1	18.1	16.5	15.1	13.8	12.9
40	32.5	32.5	32.5	32.5	31.4	28.6	26.1	23.9	22.3
	CPW_{ec}, [thousand dollars]								
10	67	67	67	67	67	67	67	67	67
16	94	104	104	104	104	104	104	104	104
25	148	178	200	225	245	245	245	245	245
40	174	209	252	304	342	342	342	342	342

Table 2

TTUS - FS-Al Transformers, Loads (S_{Mpec}) *and Losses Costs* (CPW_{ec})

S_{nT} MVA	T_S, [hours/year]								
	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	8,760
	S_{Mpec}, [MVA]								
10	13.0	11.9	10.8	9.8	9.0	8.2	7.5	6.8	6.4
16	20.5	19.8	19.1	18.5	17.4	15.9	14.5	13.3	12.4
25	32.5	32.5	32.5	32.5	31.9	30.9	28.3	25.9	24.2
40	52.0	52.0	52.0	52.0	52.0	52.0	47.7	43.6	40.8
	CPW_{ec}, [thousand dollars]								
10	95	95	95	95	95	95	95	95	95
16	145	162	182	206	221	221	221	221	221
25	169	203	245	296	343	390	390	390	390
40	249	298	360	434	524	637	637	637	637

Table 3

TTUS - NS-Cu Transformers, Loads (S_{Mpec}) *and Losses Costs* (CPW_{ec})

S_{nT} MVA	T_S, [hours/year]								
	1,000	2,000	3,00	4,000	5,000	6,000	7,000	8,000	8,760
	S_{Mpec}, [MVA]								
10	8.2	8.2	8.2	7.0	7.2	6.6	6.0	5.5	5.1
16	13.0	13.0	12.7	11.9	10.8	9.8	9.0	8.2	7.7
25	20.5	20.5	20.2	19.5	18.9	18.3	17.8	16.4	15.3
40	32.5	32.5	32.5	32.5	32.5	32.5	32.5	30.1	28.1
	CPW_{ec}, [thousand dollars]								
10	61	74	89	100	100	100	100	100	100
16	86	103	118	125	125	125	125	125	125
25	117	141	165	185	210	237	269	273	273
40	169	203	245	296	356	429	515	529	529

Table 4
TTUS (with Increased u_k) Transformers, Loads ($S_{M\mathrm{pec}}$) and Losses Costs (CPW_{ec})

S_{nT} MVA	T_S, [hours/year]								
	1.000	2.000	3.000	4.000	5.000	6.000	7.000	8.000	8.760
$S_{M\mathrm{pec}}$, [MVA]									
25	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4
40	32.5	31.9	30.1	28.6	27.1	25.8	24.7	23.6	22.9
63	52.0	50.4	45.9	41.7	38.0	34.6	31.6	28.9	27.0
$\mathrm{CPW_{ec}}$, [thousand dollars]									
25	139	167	201	243	293	352	423	506	579
40	277	321	344	375	406	443	488	533	574
63	345	389	389	389	389	389	389	389	389

Table 5
Oil Transformers with Copper Windings, Loads ($S_{M\mathrm{pec}}$) and Losses Costs (CPW_{ec})

S_{nT} MVA	T_S, [hours/year]								
	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	8,760
$S_{M\mathrm{pec}}$, [MVA]									
40	32	32	32	32	32	28	25	23	21
63	52	52	52	52	52	45	40	36	34
$\mathrm{CPW_{ec}}$, [thousand dollars]									
40	1.2	1.4	1.7	2.1	2.3	2.3	2.3	2.3	2.3
63	1.5	1.9	2.4	2.8	3.3	3.3	3.3	3.3	3.3

5. Case Example

For EUF computation of the power transformers, a public repartition system (110 kV repartition network and 110 kV/MT stations) was considered. This system belongs to the distribution operator from our eastern country area, namely Suceava, Neamţ, Botoşani. The single line diagram of public repartition system is shown in Figs. 1 *a*, 1 *b*, 1*c*.

From the single line diagram analysis of the considered system it follows that the 110 kV repartition network works in complex looped configuration at winter steady-state. Also, the repartition network comprises 168 lines (110 kV) with one or two circuits, 35 step-down stations (110 kV/MT) with one, two or three power transformers, which presents identical or different apparent rated power, a total number of 52 power transformers. These networks supplies medium voltage distribution networks (6 kV and 20 kV networks).

In the analysed public repartition system the electric enegry is injected both in power system and in four local power plants. For the EUF determination corresponding to a network element (line or power transformer) is necessary to know the real active/reactive loads that transit the element and them variation for different steady-states of a year.

By efficient use of all load monitoring possibilities (Alpha counters, automated metering for electric energy consumption – Guardian monitoring system, supervisory control and data acquisition – SCADA) all active and

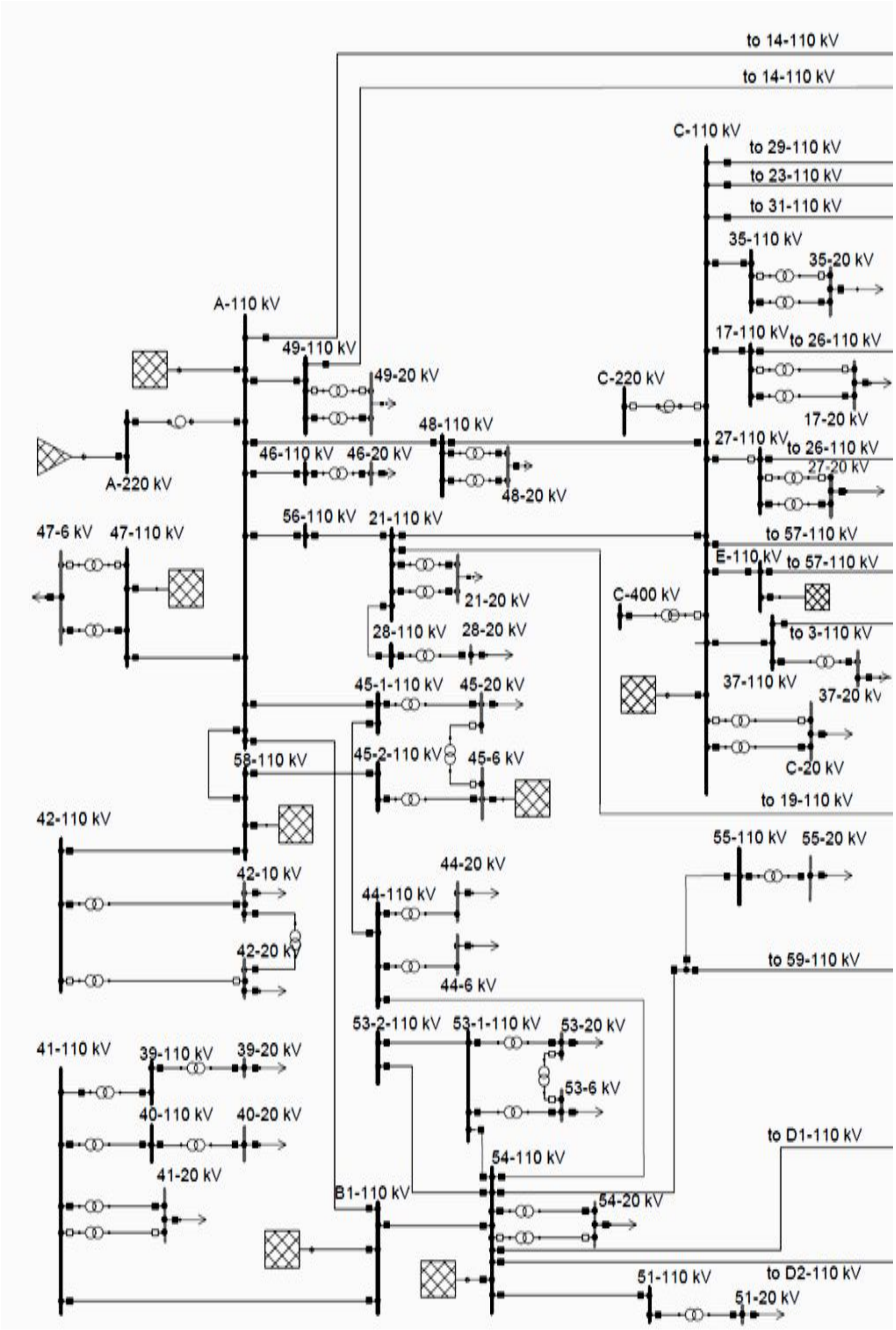

Fig. 1 *a* – Single phase diagram of the analysed repartition system.

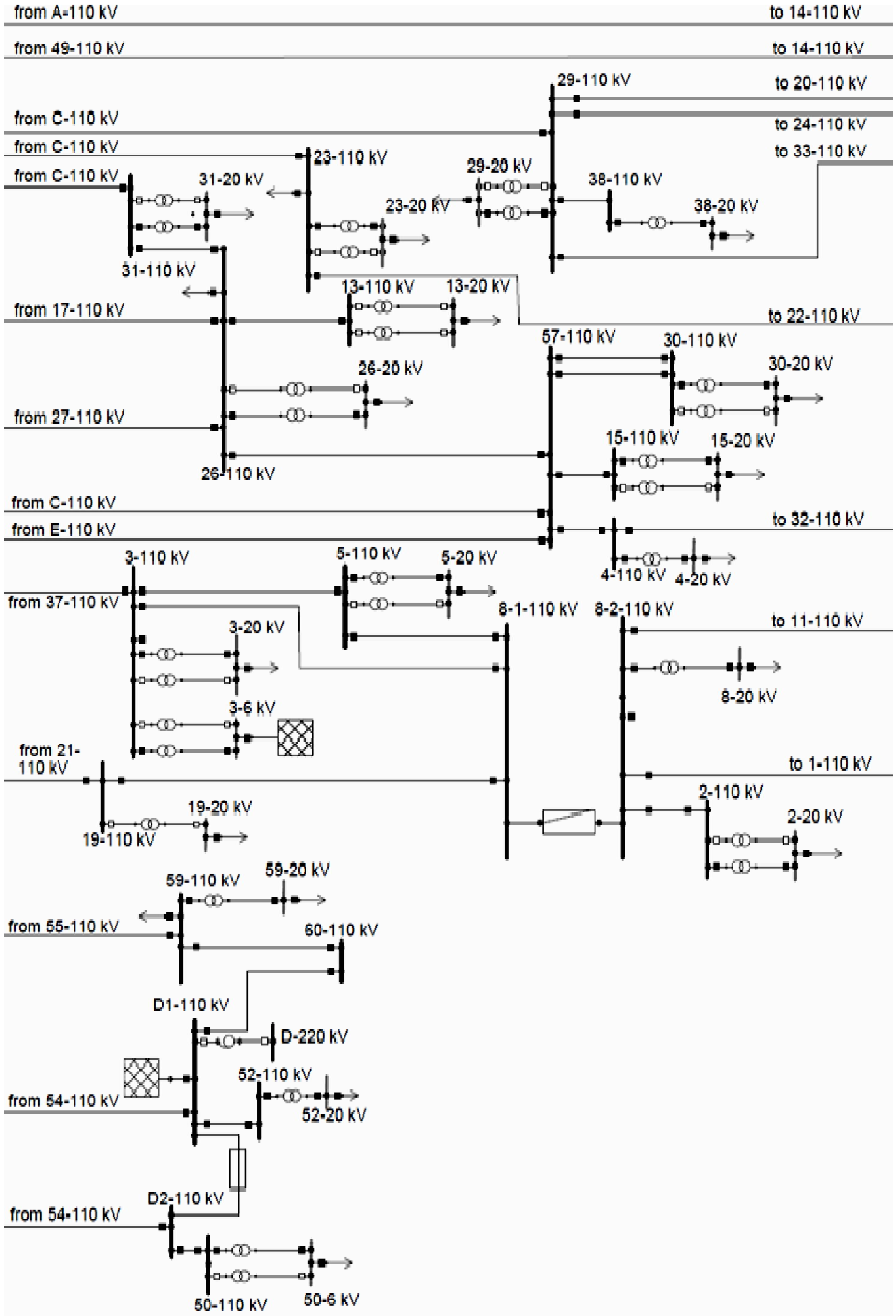

Fig. 1 *b* – Single phase diagram of the analysed repartition system.

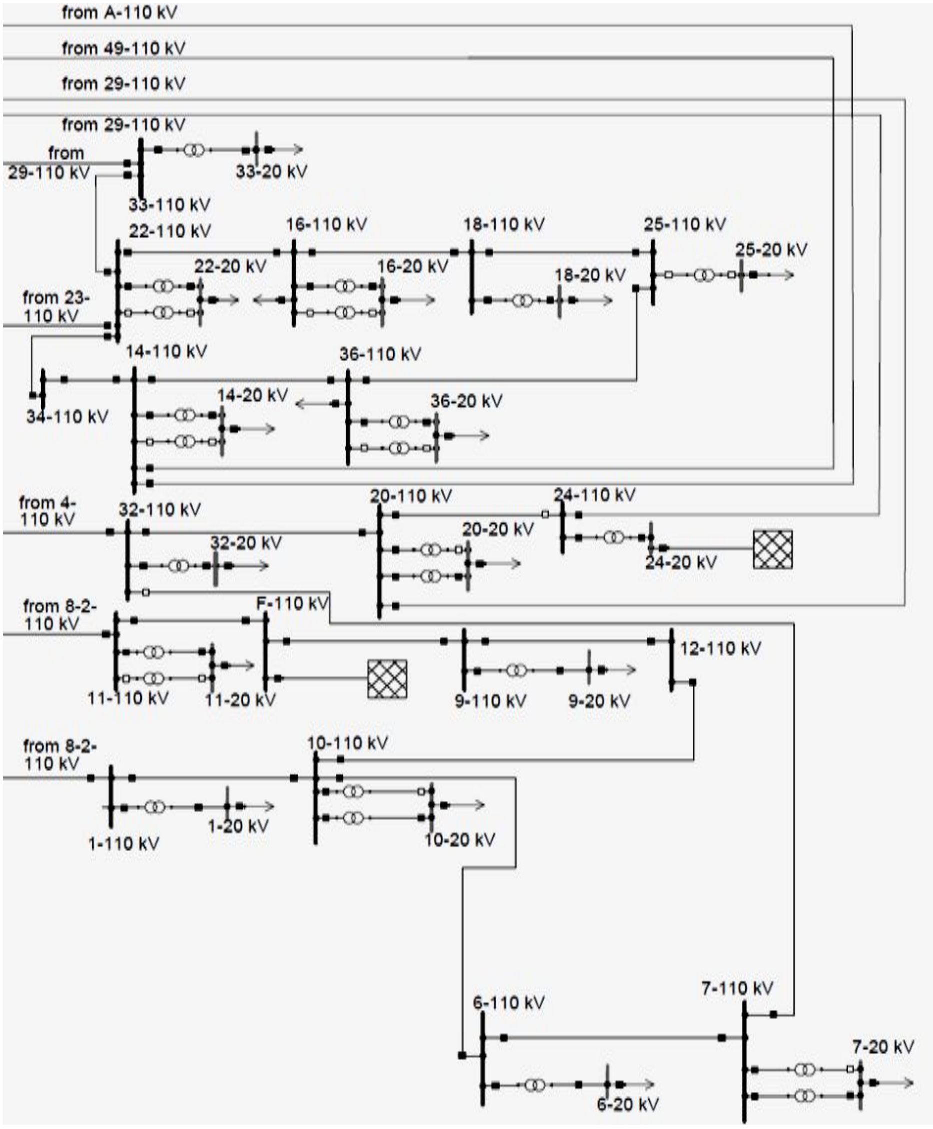

Fig. 1 *c* – Single phase diagram of the analysed repartition system.

reactive load curves at MV bars of 110 kV/MV step-down stations during 2013 year were recorded and stored. From daily load curves analysis of cold winter state revealed that the most loaded working day was Wednesday, January 16, 2013.

In order to perform this study, the daily load curves and, particularly, the load curve of most loaded working day were processed as 24 hourly levels; each level represents the average load of one hour. Knowing the topology and

Table 6
The EUF Values for Power Transformer of the 110 kV/MV Station from the Repartition System

Node name	Element name	S_n MVA	W_P MW.h	W_Q MVAr.h	W_S MVA.h	$S_{\max}$ MVA	$T_{s\text{ day}}$ h/day	$T_{s\text{ year}}$ h/day	$S_{M\text{pec}}(T_s)$ MVA	GUT %
1-110 kV	TR1-1	16	94.87	29.85	99.46	5.20	19.72	7,196.47	7.77	66.87
10-110 kV	TR10-2	16	99.33	24.15	102.23	5.62	18.73	6,838.03	8.01	70.17
11-110 kV	TR11-1	10	86.64	23.28	89.72	5.02	18.42	6,723.64	4.74	105.83
14-110 kV	TR14-2	25	45.33	14.39	47.56	2.71	18.08	6,598.29	15.66	17.30
15-110 kV	TR15-1	10	79.74	24.37	83.38	4.47	19.22	7,014.17	4.60	97.15
16-110 kV	TR16-1	25	198.44	40.57	202.54	10.16	20.52	7,491.11	14.46	70.30
17-110 kV	TR17-2	25	83.90	31.00	89.44	5.11	18.03	6,580.92	15.69	32.56
18-110 kV	TR18-1	25	25.63	8.89	27.13	1.74	16.05	5,856.71	16.73	10.41
2-110 kV	TR2-2	16	185.62	28.74	187.83	9.88	19.57	7,143.56	7.80	126.73
20-110 kV	TR20-2	40	596.57	303.05	669.13	29.46	23.39	8,538.05	23.04	127.88
21-110 kV	TR21-1	25	247.16	40.17	250.41	14.43	17.87	6,521.85	15.77	91.53
22-110 kV	TR22-2	10	127.89	32.22	131.89	7.81	17.40	6,350.68	4.92	158.69
23-110 kV	TR23-1	16	164.02	38.52	168.48	8.70	19.94	7,277.15	7.71	112.89
24-110 kV	TR24-20	16	44.42	10.48	45.64	4.37	10.75	3,922.44	10.41	42.02
26-110 kV	TR26-2	16	156.95	60.76	168.30	8.36	20.73	7,565.83	7.50	111.51
27-110 kV	TR27-2	16	145.63	28.75	148.44	7.79	19.63	7,165.99	7.78	100.10
28-110 kV	TR28-1	25	119.46	27.02	122.48	7.15	17.63	6,435.73	15.89	45.03
29-110 kV	TR29-2	25	98.62	24.23	101.56	7.28	14.36	5,242.32	17.71	41.12
3-110 kV	TR3-3	25	93.58	38.22	101.09	7.66	13.59	4,962.15	18.84	40.65
3-110 kV	TR3-2	16	43.34	7.69	44.02	2.70	16.81	6,137.42	8.50	31.72
32-110 kV	TR32-1	10	98.50	11.92	99.22	5.69	17.97	6,558.76	4.82	117.99
33-110 kV	TR33-1	10	65.90	22.11	69.51	4.35	16.45	6,004.42	5.10	85.34
35-110 kV	TR35-2	16	232.43	59.54	239.93	13.53	18.27	6,666.80	8.13	166.42
36-110 kV	TR36-2	25	253.29	50.25	258.23	13.56	19.61	7,157.45	15.30	88.65
37-110 kV	TR37-1	16	90.84	19.01	92.81	5.80	16.48	6,016.90	8.59	67.51
38-110 kV	TR38-1	10	48.26	10.60	49.41	3.05	16.67	6,084.80	5.06	60.34
39-110 kV	TR39-1	16	85.72	4.46	85.83	4.72	18.72	6,831.92	8.02	58.89
4-110 kV	TR4-1	10	95.46	35.60	101.88	5.99	17.53	6,398.05	4.90	122.17
40-110 kV	TR40-1	16	96.91	32.00	102.06	5.22	20.15	7,353.91	7.65	68.20
41-110 kV	TR41-1	10	155.31	69.25	170.05	8.62	20.32	7,415.75	4.43	194.60
42-110 kV	TR42-1	16	167.95	64.64	179.96	9.93	18.67	6,813.41	8.03	123.66
44-110 kV	TR44-1	25	60.93	13.11	62.32	3.27	19.61	7,157.48	14.90	21.97
44-110 kV	TR44-2	25	60.93	12.99	62.29	3.28	19.59	7,149.56	14.90	21.98
45-1-110 kV	TR45-1	25	131.23	42.35	137.89	7.11	19.96	7,286.36	14.72	48.33
45-2-110 kV	TR45-2	25	44.77	11.93	46.33	3.57	13.37	4,878.80	18.22	19.59
46-110 kV	TR46-1	16	130.81	37.20	136.00	6.99	20.05	7,318.42	7.68	90.97
47-110 kV	TR47-2	10	11.33	5.87	12.76	0.57	22.92	8,367.41	4.13	13.88
48-110 kV	TR48-1	25	378.20	70.69	384.75	20.58	19.26	7,029.17	15.06	136.64
49-110 kV	TR49-2	10	86.17	36.26	93.49	4.90	19.66	7,176.08	4.53	108.12
5-110 kV	TR5-2	16	84.64	25.42	88.37	4.68	19.44	7,096.09	7.93	59.04
50-110 kV	TR50-1	16	29.74	4.97	30.15	1.64	19.00	6,933.29	7.95	20.57
51-110 kV	TR51-1	16	64.35	9.56	65.05	3.46	19.38	7,074.38	7.85	44.04
52-110 kV	TR52-2	10	73.91	8.72	74.42	4.67	16.43	5,995.24	5.10	91.51
53 1-110 kV	TR53-1	25	40.73	6.40	41.23	2.03	20.88	7,621.92	14.29	14.23
53 2-110 kV	TR53-2	25	108.02	17.47	109.42	7.90	14.26	5,204.74	17.77	44.48
54-110 kV	TR54-2	25	256.39	66.22	264.81	14.21	19.19	7,005.49	15.10	94.11
55-110 kV	TR55-1	10	34.77	6.53	35.38	2.04	17.87	6,523.94	4.94	41.27
59-110 kV	TR-59-1	25	259.62	45.41	263.56	13.90	19.52	7,126.56	14.93	93.13
6-110 kV	TR6-1	10	89.10	25.88	92.79	5.54	17.25	6298.00	4.95	111.89
7-110 kV	TR7-2	16	193.59	25.08	195.21	10.77	18.66	6,812.30	8.03	134.16
8-2-110 kV	TR8-1	16	216.07	69.75	227.05	12.71	18.39	6,713.44	8.10	156.97
9-110 kV	TR9-1	10	61.40	11.25	62.42	3.47	18.54	6,768.92	4.72	73.45

material network characteristics and hourly loads to the MV station bars, and by using NEPLAN application, 24 steady-state of repartition system for Wednesday, January 16, 2013, was calculated.

Based on the results given by NEPLAN application, the state quantities for the 24 hourly states of the analysed repartition system, and by using the presented methodology in the previous section, the EUF values in the most loaded working day of cold winter state have been established.

The results are detailed in Table 6, which contains the following information: node number, name element, apparent nominal power, daily active reactive and apparent energy, daily and yearly maximum apparent load duration, the maximum apparent load that transit the power transformer and the EUF transformer.

6. Conclusions

A rational operating of an ERDS is conditioned especially, by whole system capacity and its element from all voltage levels (110 kV, 20 kV and 0.4 kV), to allow both power and energy losses minimization and the improvement of power quality delivered to consumers.

Regarding the policy concerning the power quality supplied, power and energy losses minimization, power transmission yield and the related management methods; they represent priorities for each territorial electric energy distribution and supply company. The aforementioned priorities must be harmonized with the general company development strategy, with *Quality – Environment – Health* and *Occupational Safety* integrated management system.

Periodic determination (annual) of EUF must be interpreted as a necessary action in operation that aims to systematically pursue the economic health and opportunities available for public ERDS. Moreover, the EUF determination can be interpreted as a mobile or an incentive one for the substations and stations endowment with strictly necessary measuring equipments for a rational operation both technical and economical points of view.

In the paper, according to the current instructions from our country, the analysed 110 kV network of the distribution operator from eastern area of our country comprises 168 lines (110 kV), 35 step-down stations (110 kV/MT) with 52 power transformers, the EUF values for each network element were established. Fig. 2 shows, in graphical form, the EUF values for power transformers corresponding to most loaded working day – Wednesday, January 16, 2013.

Based on detailed results regarding the EUF values of power transformers from analysed repartition system, summarized in Table 6 and Fig. 2, the following issues can be drawn:

1. For power transformers with EUF more than 100% it results that

through the transformer a greater load than the economic one for which has been dimensioned at the design stage is transited. Therefore, in such cases, both the longitudinal losses cost from transformer windings and the total updated expenses are greater than their economic value, corresponding to GUT = 100%.

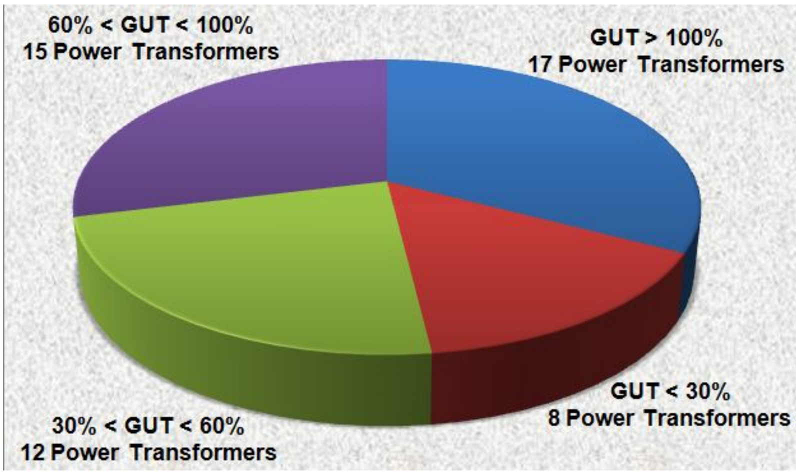

Fig. 2 – The classification of EUF values of power transformers at various loading levels.

2. For power transformers with EUF less than 100% it results that through transformer a lower load than the economic load, corresponding to GUT = 100%, for which has been dimensioned at the design stage is transited. Therefore, the cost of longitudinal losses (thermal effect) in transformer windings and the total updated costs is lower than the economic value corresponding to a GUT = 100%, of 1.5 in the 60% EUF case and more than three when the EUF falls below 30%.

3. For power transformers with EUF less than 60% the practical possibilities to increase of this indicator in current operation must be established. For example, the EUF value can be increased by redistribution of the consumers supplied from the 110 kV/MV step-down stations.

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ANALIZA GRADULUI DE UTILIZARE ECONOMICĂ A TRANSFORMATOARELOR DE PUTERE DIN SISTEMELE DE REPARTIŢIE A ENERGIEI ELECTRICE

(Rezumat)

O funcţionare raţională şi, în acelaşi timp, eficientă din punct de vedere tehnico-economic a unor sisteme de repartiţie şi distribuţie a energiei electrice este condiţionată de capacitatea acestora de a permite creşterea randamentului de tranzit al energiei electrice, minimizarea pierderilor de putere şi a celor de energie activă, îmbunătăţirea calităţii energiei electrice livrate consumatorilor, reducerea daunelor datorate calităţii necorespunzătoare a energiei electrice etc. Având în vedere aceste aspecte, în cadrul lucrării s-a analizat gradul de utilizare economică (GUT) a instalaţiilor electrice de 110 kV din zona de N-E a ţării noastre, la nivelul celei mai încărcate zile lucrătoare din regimul rece de iarnă. Pe baza rezultatelor furnizate de o astfel de analiză pot fi selectate elementele sistemului de repartiţie a energiei electrice (linii electrice şi transformatoare de putere), ce urmează a fi supuse unor analize mai atente şi mai aprofundate, în vederea creşterii posibilităţilor de care dispune sistemul de repartiţie considerat, pentru atingerea dezideratelor din punct de vedere tehnico-economic, deziderate urmărite de fiecare societate teritorială de repartiţie şi distribuţie a energiei electrice.