THE ESTIMATION OF CONSUMPTION EVOLUTION AS A DETERMINANT FACTOR IN OPTIMAL POWER TRANSFORMERS UTILIZATION

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INTRODUCTION

To solve the problems of the electrical distribution networks we need to know the determinant factors.

STUDY

To establish the optimum way of development – grid systematization analyze must be made on the optimized skeleton, with low costs, with corresponding safe, with appliance of new solutions of exploitation.
The grid development is a complex problem which must follow the market economy (tacking in account the economic situation of Romaine), the modifications which exist in electrical consumption evolution.
Knowing the consumption importance in grid dimensioning is important to estimate as exactly as possible.
In this paper it was consider an area of Galati city (a residential district) for which it was made the case study.
The determination of power and energy consumption it was structured:

- It was recorded the consumption for the years 1993, 1994, 1996;
- It was estimated the consumption for 1997-2010 in two ways of consumption evolution;
- It was determinate the global consumption;
- It was considered control value for the ridings in years 2001-2006.

After this study it can be said, the chose way of estimate for the consumption evolution, is a logical necessity to determinate the optimum in using of power transformers.

1.The global evolution consumption determination

it was made with the next hypothesis:
- The domestic consumption it has a predictable dynamic, in conformity with the superior variant determinate from the anterior recordings;
- The urban development follows the urbanism design, unpredictable evolutions (local markets, commercials spaces, etc.)
- The application of the obtained results to a global area (entire city) is not consider the city extension and is not for the industrial area where the consumption diminution will conserve the consumption which already has a feed reserve.
The dynamic of construction roost is diminution due to material situation and available space in the area. It was observed an augmentation for the commercial buildings in this district predominant domestic.
Using the estimated consumption it can be determinate in the case study the needed equipment and the next system configuration.

1.1 The Production and Distribution Installation of electrical energy – Analyzed District

The M.V distribution grid:
- on 6 kV app. 75% and
- on 20 kV app 25%.

The LV- 0,4 kV:
- to feed domestic and commercials consumers – underground grid.
- to public illuminating aerial and underground grid.

Feed station we have:
- on 20 kV station 110/20 kV;
- on 6 k v station 110/6 kV.

1.2. The determination of power and energy consumption for the period 1996-2000 and 2001-2010, on consumers' category.

The definition of estimation methods
It was analyzed two methods:
A) Method 1 – in time consumption evolution in conformity PE 132/2003.
B) Method 2 – in time consumption evolution with mettering and quadratic interpolation.

Method 1 – in time consumption evolution in conformity PE 132/2003 using input data the mettering.
As input data, the recordings on the posts and on each feeder (where those exist) were necessary, for the power consumption determination absorbed by groups of

consumers, in year 1996.

A. For domestic consumers the degree of augmentation for the absorbed power on consumer (resulted after readings) is in conformity with PE 132/2003, the evolution in time being given by an exponential function.

Because there is not a correlation between the effectuated readings and the feeders we'll proceed in the next way:

- We identify the posts where a category of consumers is predominant and that feeder feed, without reserve, this category (in correlation with individual readings on each consumer type in year 1996);
- If the calculated values, with a reduce dispersion are corrected with the simultaneity coefficients in conformity with PE 132/2003, then we can identify which feeder feed that category of consumers.

The category easy identifiable, major as balance, importance and fluctuation is the one of domestics consumers with one and two rooms.

The moment of readings give as a set of primary data unorganized, uncorrelated strictly on feeder by assumption at a grand dispersion of values for the specific consumption on the category of domestic consumption.

To obtain real results it was made a careful analyze of distribution configuration in parallel with the classification on the category of domestic consumers.

It was identified five categories of domestic consumers:

A) Building P+4 levels – flat with 2-3 rooms – Category A.4.2.
B) Building P+9 levels – flat with 2-5 rooms – Category A.9.2.
C) Building P+4 levels – flat with 1 room – Category A.4.1.
D) Building P+9 levels – flat with 1 room – Category A.9.1.
E) Particularly homes; in conformity with PE 132/2003 the charge will be 2,5 kW/flat – flat with 2-5 rooms) – category A2.

From four posts it was identified without reserve feeders which feed categories of similar consumers with a reduced dispersion and with a controllable charge of situation.

The determinate values it was extrapolated to entire area and using them it was identified, by elimination, the consumption realize by specials consumers with a big dispersion of values and configurations (groups of garages, boutiques, etc.). In other words those will be determinate – by global analyze – eliminating the domestic consumption, characterized for big groups by superior stability and predictability.

The correlation of feeder on consamtion category it was made using:

- On phase distribution;
- The moment of readings;
- Consumption level;
- Unbalanced feeder.

The simultaneity coefficient it is applied to feeder.

The specific power (kW/flat) calculated must be correlated by the point of view of effective power consummated on each category of consumption.

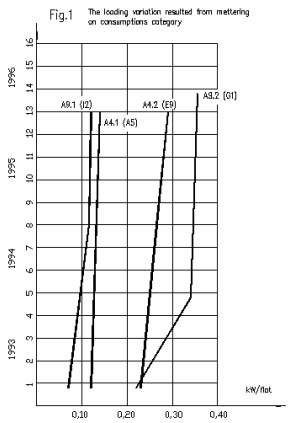
In conformity with results, we'll considerate like calculus power reference on consumer type the next values with mention that for an apartment with one room without gas in a building with 4 level it is appended 0,415 kW in conformity with PE 132/95 (on calculus of power on the apartment at buildings with more than 4 level it is appended 0.1 kW which represent the common consumption: illumination, elevator, etc.)

- Apt. with 2-5 rooms – P + 4 levels – 0,91 kW/flat;
- Apt. with 2-5 rooms – P + 9 levels – 1,081 kW/flat;
- Apt. with 1 room without gas – P + 4 levels – 0,415 kW/flat;
- Apt. with 1 room without gas – P + 9 levels – 0,515 kW/flat

The evolution of the domestic consumption in conformity with the first method will follow the next low of variation

Because it was not information about the evolution in time of concentric consumers it was considered an annual augmentation of 1% to year 2000 when is stabilized.

Using the presented data we can obtain the curve of fig. 1.



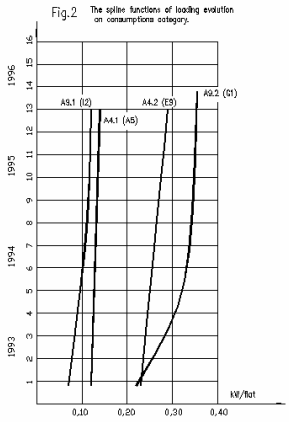


Fig 1 The loading variation resulted from mettering on consamtion category

Fig 2 The spline function at consamtion category.

The second method of estimation with evolution in conformity with readings

There was used recording from 1993, 1994 and 1996, on the individual and global feeders where those exist and can be correlated by identifying firmly the types of consumers on the respectively feeders.

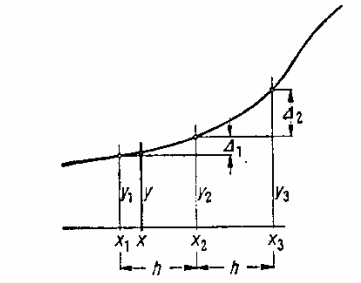
For the presented feeders it will be considering, the recording successively made in 1993, 1994 and 1996.

The consumption evolution in conformity with the recording in relative values 1993, 1994 and 1996.

Like in the precedent analyze (the first method) the transformers post with firmly identified feeders which feed category of consumers similarly with reduced dispersion and with a controllable load as follow:

A) PT 251 – 16 clase – category (4);
B) PT - 186 – Gl – category (2);

C) PT 33 – I2 categoriile (3) and (1);
D) PT 16 – B2 – category (1);
For PT –"16 Clase" in 1993 it was considered as input data the global readings. It was resulted a power on feeder representative for buildings with apartments of 1 room, without gas, which was corrected in 1996 (in this way in 1993 from global readings it was resulted a calculus power on apartment of 0,092 kW/ap corrected with 69,705 = 0,121 kW/ap.)
Using the obtained data we can have the curves from fig. 1
Analyzing the curves result obviously that we have not a linear evolution.
If we associate the curves with a function of degree "k" which impose to pass by the beginning point and end point of consumption evolution, we can analyze the consumption evolution on characteristics limit superior of linear evolution which will result from two last year (1994 and 1996 in our case) and obviously more realists, knows being the trends of domestic consumption linearization from analyzed area.
Precisely, the degree of using appliances in limited space (like the apartments) is high, the evolution of consumption in conditions of conservation energy price, reported to populations incoming, can not have a spectaculars branch.
The polynomial function of collating from the first point to last point of a polygonal line open it will be generated by a "spline" function.
The generation of polynomial function it was realized with CAD (Computer Aided Design) on Edit command "S" option, which calculus and trace a function "spline" which will pass only by the first and last point of polygonal line.
By definition a function "spline", is a composed polynomial function of degree "k" with the continuity of derivation of order "k=1" in junction points.
After the editing of lines shown in fig. 1a result the curves presented in fig. 2 with reserve that for A.4.1 category – where we have just two points of consumption – the evolution was and remain linear.
Having the curves of polynomial function we can proceed to determinate the coliating polynoms which describe the illustrated curves.
The trends of curves give us the right to proceed at numerical coliating square form:
Mathematical_function



$$y = y_1 + A_1(x - x_1) + A_2(x - x_1)^2,$$

$$\xi = \frac{x - x_1}{x_2 - x_1}, \qquad 0 < \xi < +2,$$

$$\Delta_1 = y_2 - y_1, \qquad \Delta_2 = y_3 - y_2,$$

$$h = x_3 - x_2 = x_2 - x_1$$

$$0{,}5 < \xi < 1{,}5$$

$$\boxed{y = y_1 + \frac{\xi}{2}(3 - \xi)\,\Delta_1 - \frac{\xi}{2}(1 - \xi)\,\Delta_2.}$$

For both methods are commune the next points:
a) According with the consumption evolution in analyzed area for public illumination in 1993, 19994 and 1996 it was presented – initially – in table (the data was provided by energy provider – Galati).
The exploitation increasing the domain of definition of function to the period purpose must to use this.
The utilization of functions can be made changing the tabled given function with a polynomial function which take the same values as the function for certain value (known) for the argument.
Before this it was obtained the curve of consumption variation in period 1993 – 1996 and the trend show an evolution in arc of parabola with trend of linearization.
The algorithm of interpolation of unknown function defined on 1996 – 2010 (0 – 17 fi(x) for imposed conditions fi(1993) = m; fi(1994) = n fi(1996) = p: using the polynomial function: $P(x) = ax^2 + bx + c$ give as the solution of system.
b) For concentred consumers from analyzed area, because it was not information regarding the evolution it was considered an increasing of 1% to year 2000 when is stabilized.

1.3. Choosing the first method

After the analyze of the two method, we consider that is necessary to chose the method of superior consumption determined respectively the method I (fig 3) which have a more aggressive evolution then the second method (fig 4).
The evolution of power consumption on category of consumer for the first method is shown in fig. 3.

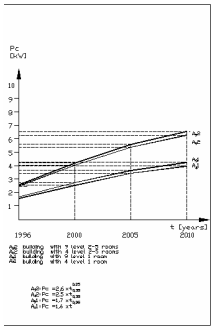


Fig 3 The first method of prgnosis.

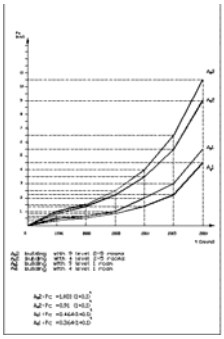


Fig 4 The second method of prgnosis.

1.4. The application of estimation method

First of all it was depart from an existent structure of m.t. and j.t. electrical network which was calculated for years 1996, 1997, 1998, 1999, 2000 and 2010 (the results being systematized on the structure of existing networks, shown in this way the conclusion imposed for this analyze, eventually reconfiguration of networks.
In consequences:
- at year 1996 level, PT 12 Autoservire, PT B2 and PA 5 is situated at high limit of load, even existing the possibility that for a maximum consumption for all the consumers simultaneously, those supply drop down.

2. The determination of network structure

In function of consumption evolution establish in 1.2. section it was resulted:

- the maximum consumption of power for 1996 is 4,9MW;
- the number of transformer posts is 22 from which 18 transformer posts 6/0,4 kV and 4 transformer posts 20/0,4 kV.

3. Statistic data, actual situation

Tiglina I district have a total area of 1,13 km^2 from which:

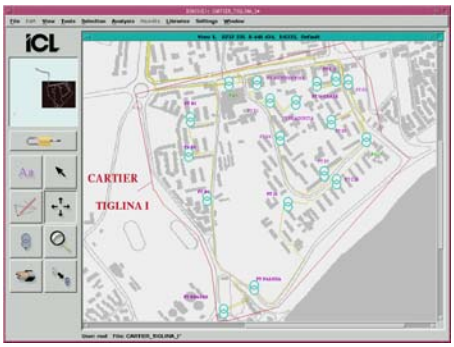


Fig 5 The Tiglina district

- 0,18 km^2 is occupied with edilitary and commercial consoumers;
- 0.92 km^2 is occupied with buildings with apartments 4 and 9 levels;
- 0,03 area with maisons.

4.The verification of the method of prognoses.

Using the results of the study the consumption in studied area between 2000 and 2006. (Chart 1).

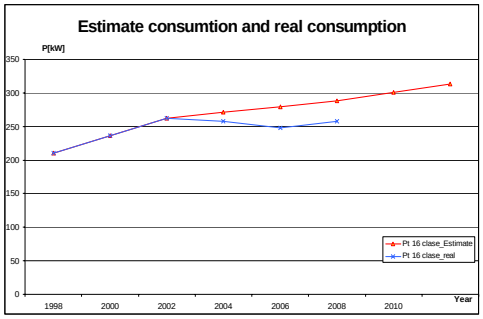


Chart 1-Estimate and real consumption

Considering that Romania is passing throught a transit period, that the population has medium incomes and that the cost of energy has decrease the consumption in same cases the level went under the value registered in 1996.

CONCLUSIONS

After this study we can say that the choosing the method of evolution consumption estimation is a necessity of the present in determination of optimum in power transformer utilization.
Determination factors :the cost of energy, the financial state of the people and economical evolution of the area.

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