STUDY REGARDING THE POWER AND ELECTRICAL ENERGY LOSSES IN ELECTRIC LINES OF LOW VOLTAGE CABLE

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Abstract: Based on the configuration of National Power System of the distribution of electricity to low voltage consumers from urban system and given the percentage of electricity losses in the electrical supply cables to these consumers ,the paper aims to conduct a study case in this regard. For the analysis of the power losses in the paper it will be performed an experimental study on a three-phase low-voltage power consumers connected to the electricity distribution network by an electrical cable with section of $4 \cdot 2{,}5\ mm^2$.

Keywords: distribution, electrical, energy, electric lines

1.INTRODUCTION

Knowing the principle schemes and characteristic parameters of the main elements that make electricity networks (generators , transformers , lines, reactors , electric motors) it can calculate their main parameters required for the calculation of voltage drop , power and energy losses ,short-circuit current and earth movement calculation and the calculation of the circulation of the loads [1] .

With the calculated parameters it can be produced equivalent schemes of network components, allowing the calculation of their power .

In order to determine the energy consumption of a certain shape of a physical production system or of the outline of a component part it is used the energy balance [2] .

Energy balance has as main aim, differentiating the consumptions into useful components and losses, but also the analysis of energy consumption reduction and increasing the efficiency of energy use in the technologic flow scheme [2].

Since in the exploration ,the primary equipment are under the influence of some perturbations that deviate parameters from the prescribed values it has to be intervened to restore them to normal values [3].

Also, in some cases, even under the conditions of normal parameters ,it appears the need of willful change of electrical network configuration for transmission and distribution [3].

To determine the power and electricity losses in the network elements the following simplifying hypothesis are made [1] :

- it is considered symmetric and balanced three phase network ;
- transverse losses are neglected;
- neglecting losses from deforming regime ;
- the average power factor at consumer terminals are considered from 0.90 to 0.92.

The work developed aimed to determine the losses in the dielectric of the electric power cable of an electric motor with squirrel cage induction powered from a power distribution panel entering in the laboratory configuration of "Electrical equipments", of the Faculty of Engineering.
The distribution switchboard of energy realize the boundary point between the interior three-phased electric network of low voltage inside the laboratory and asynchronous electric motor power cord, while also ensuring for the electric motor the protection - switching - signaling processes.
Asynchronous electric motor control is achieved local through local drive on / off button located on the electrical panel distribution and the position of the switching device (contactor) is indicated visually by two signal lamps placed all the interface of distribution switchboard .

2. DETERMINING THE POWER LOSSES IN THE DIELECTRIC OF THE ELECTRIC POWER CABLE OF THE MOTOR

Electrical motor with the rotor in short-circuit ,which is the subject of the case study of the paper has the following characteristics:

- delta / star connection;
- nominal supply voltage 220/380;
- rated current afferent two connection options 2.05 / 1,019;
- 0.7 kW rated power.

The rotor of electrical motor is provided with a coupling system on which a healthy braking system which provides the ability to simulate both the normal operation and the overload of the motor system , acts progressively .
The Power supply of asynchronous electric motor from the power supply was made from a switchboard distribution through a three-phase electric cable,CYY type ,with four copper conductors of section 4 * 2.5mm^2 and 30 m length.

The case study aimes at analyzing the variations of power losses in the dielectric of the electric power cable motor according to nominal supply voltage and the electric cable length. To calculate the power losses in the power cord of the electric motor by electric cable type and section it was established specific electrical resistance and reactance, capacitance and the loss tangent angle of the dielectric cable
Power losses in power cord asynchronous electric motor for the six variants of length were determinated using the formula[1]:

$$\Delta Pel = \omega * C * U^2n * tg\ \delta \quad [W] \qquad (1)$$

Where :

ω- angular,

C – capacitance,

Un – rated voltage of the power grid,

tg δ – the losses tangent angle of power dielectrical cable of asynchronous electrical motor

Pulse value is determined by the frequency of the power system with the value of 50 Hz, according to the expression: [1]:

$$\omega = 2 * \pi * f\ [Hz] \qquad (2)$$

Starting from the electric cable type ,the conductor material the conductors are made and its geometric characteristics (length, section) are chosen electrical parameters related to the determination of power losses in the dielectric of the power electric clable,of the asynchronous motor which is case study subject [2].
Table 1 presents the values of electrical resistance and ability to work according to resistance, reactance and specific capacity values for more lengths of electric cable, beginning from the true value for the case study was done.

Table no.1. The values of the electric cable parameters of power motor

No.	Length of cable l [m]	Specific Resistivity R0[Ω/km]	Specific Reaction X0[Ω/km]	Specific Capacitance C_0[μF/km]	Electrical resistance Re[Ω]	Capacitance Ce[μF]
1.	30	12,1	0,07	0,105	0,363	0,0031
2.	60	12,1	0,07	0,105	0,726	0,0063
3.	90	12,1	0,07	0,105	1,089	0,00945
4.	120	12,1	0,07	0,105	1,452	0,0126
5.	150	12,1	0,07	0,105	1,815	1,01575
6.	180	12,1	0,07	0,105	2,178	0,0189

Using the relation we calculated (1) ,for a nominal supply voltage of the electric motor of 220 V , specific triangle connection made in asynchronous motor terminal board , on which it was made the case study,it resulted the power loss values in the dielectric of the electric cable shown in Table 2 .

Table n0.2. Power loss values in the dielectric of the electric cable, for a nominal supply voltage of the electric motor of 220 V

No.	Capacitance Ce[μF]	Rated voltage Un[V]	Dielectric loss angle tangent tg δ	Electrical power losses [kW]
1.	0,0031	220	0,008	0,0003769
2.	0,0063	220	0,008	0,0007659
3.	0,00945	220	0,008	0,0011489
4.	0,0126	220	0,008	0,00153
5.	0,01575	220	0,008	0,001915
6.	0,0189	220	0,008	0,00229

Using the relation we calculated (1) ,for a nominal supply voltage of the electric motor of 380 V , specific to triangle connection made in asynchronous motor terminal board , on which it was made the case study,it resulted the power loss values in the dielectric of the electric cable shown in Table 3 .

Table no.3. Power loss values in the dielectric of the electric cable, for a nominal supply voltage of the electric motor of 380 V

No.	Capacitance Ce[μF]	Rated voltage Un[V]	Dielectric loss angle tangent tg δ	Electrical power losses [kW]
1.	0,0031	380	0,008	0,001124
2.	0,0063	380	0,008	0,002285
3.	0,00945	380	0,008	0,003427
4.	0,0126	380	0,008	0,0045704
5.	0,01575	380	0,008	0,005713
6.	0,0189	380	0,008	0,006855

3.CONCLUSIONS

Following the case study conducted on the system of feeding induction asyncronous motor with the rotor in short-circuit , the following conclusions are made:

- Power losses in the dielectric of the power supply cable of the electric motor with rated power of 0.7 kW are depending on the rated supply voltage;
- Analysing the values reported in tables no. 2 and No. 3 , it is observed that the values of power losses in the wiring dielectric engine , increase threefold if three phase electric motor power (at a nominal voltage of 380 V) , compared to the situation where the supply of the electric motor is performed in single-phase system (with a nominal voltage of 220 V) ;
- Also from the analysis of the results of the calculation (according to relation 1) for the power losses in the dielectric of the electric supply cable of the electric motor with rated power of 0.7 kW, it appears that their value increases with increasing length of the wiring .

4. REFERENCES

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