CONTRIBUTIONS TO THE RATIONAL METHOD OF NEUTRAL EARTHING WITH MATLAB+SIMULINK

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***Abstract* – Till present day the problem of electricity networks neutral of medium voltage treatment is argued hotly by the specialists in energetics. The present problem is analyzed from different points of view in numerous scientific articles: safety factor of consumers supply with electric energy, current magnitude in the place of defect and overvoltages on the healthy phases of one phase earth connection; protection schemes through the relays of contra earth connections; personnel and electrical equipment security of earth one-phased connections etc.**

***Keywords*:** *Neutral, reactance coil, one-phased fault, insulated neutral, compensated neutral.*

1. INTRODUCTION

To study and determinate the rational method of neutral treatment in networks of medium tension of electrical power engineering system of the Republic of Moldova.

2. NEUTRAL EARTHING IN THE 6-35 kV NETWORKS

At present time the countries of European Union and in the States of CIS the idea of 6-35 kV passage from neutral isolated regime or compensated neutral through interest of amortization to the neutral regime connected with the earth through the resistor.

The reasons that imposed running regime of networks 6-35 kV neutral revision are objective and include the following [2, 4, 5]:

- requirements growth concerning consumers' electrical energy supply continuation;
- requirements growth concerning reliability of consumers' supply with electrical energy;
- configuration modification and continuous growth of electrical power in the networks;
- methods and new means implementation of electrical energy distribution;
- foremost requirements growth of overvolages reduction and electromagnetic compatibility;
- requirements growth concerning selectivity, sensibility and relay protection system and automation;
- service personnel security ensuring.

In Moldova electricity networks of medium tension (6-35 kV) function in the neutral isolated regime and partial in the compensated neutral regime through the arcing ground compressor. Only these regimes of networks neutral MT were regulated by NAIE till 2003 year. Thanks to the scientific investigations in this field, other countries experience it was possible to revise the rules and in conformity with the positions of part 1 point 1.2.16 of the last edition NAIE, introduced for usage from 1 of January 2003, …"electrical networks functioning with the tensions of 3-35 kV may be foreseen with the isolated neutral and with neutral connected with the earth by acting ground suppressor or resistor".

In this way in Russia (as well as in Moldova) it is formally admitted every method of neutral realization from the world practice (exclusively direct connection with the earth).

In order to determine the rational method of neutral treatment of 3-35 kV networks it is necessary to analyze a great number of technical and economical (that are often controversial) factors and parameters. At present time there are no precise technical and economical forms, which will give the possibility to solve the problem of neutral treatment in MT networks.

The correct solution may be determined through a rather great volume of calculations and analysis.

In a normal way of neutral treatment there is no influence over the network parameters and characteristics. In emergency state of neutral treatment the situations changes radically. Phase of earth connection in electrical installations by MT constitutes the most frequent defect - ≈75%. So, the methods and means of reliability increase with electrical energy supply have to be directed to consequences prevention of earth connection and to maintain the level of isolation exploitation.

The security level of earth connection depends in a greater measure of the electrical network neutral realization – on default influences the continuity and reliability of supply.

MATLAB system and application pack SIMULIMK (corporation MathWorks, Inc.) allows mathematical modeling of dynamic linear and non-linear systems. In the present work the results of SIMULIMK- model (S-model) of an electrical network with a differently treated neutral and analysis of the obtained results.

2.1. Insulated neutral

In the networks with insulated neutral there exists a high probability of intermittent electric arc appearance of a phase of earth connection. Appreciatively 60-80% of the one-phased effects are accompanied by an electric arc.

The tensions' growth is inevitable, independently of fault appearance through the arc and character of process flowing. Maximal overvoltages may reach the capacities of $3U_{fm}$, different in the function from the initial moment of fault, by the network parameters, place of defect etc., but in some cases overvoltages may reach the capacitates of (3,5-4,5)U_{fm}. Phenomenon of resonance and one-phased faults through the intermittent electric arc transform the one-phased faults in poly-phased, this fact was demonstrated by the statistics of electrical networks of distribution [4].

The main advantage of the networks with isolated neutral is the continuity in increased functioning and one-phased currents of the reduced capacities. In fig. 1 the values tension and current through a fault in the network with the insulated neutral – as a result of modeling in SIMULINK [3]. Overvoltages in the transient process result $U_{fm}/U_f = 2,5$.

2.2. Compensated neutral

Arcing ground suppressor introduced between the neutral point and ground diminishes effect current and rosette effect through which this current circulates.

In the case of fault through electric arc, if the suppressor is well accorded, the fault is eliminated at the first passing through zero of the residualstored current, in such way the tensions on the healthy phases come back to the normal regime.

The transitional regime of becoming normal of the tension on the faulty phase is influenced by the level of accordance of BS. In case of perfect BS accordance the tension on phase comes back to normal as slowly, as the degree of damping is smaller, without overvoltages appearance. If BS is mistuned, the renewal regime is accompanied by the overvoltagess on the healthy and faulty phases [1].

In the permanent regime the galvanic effect, level of overvoltagess is close to the case of isolated neutral - $\sqrt{3}$.

Reactance coil are efficient in the on the networks of ramified calibers with big capacitive currents, but their effectiveness disappears completely in case of reactance coil are usage in the networks that supply the deformed consumer. In this case the current of earth appear superior harmonic, which may be strengthened by the network capacities. Reactance coil are compensates only the composition of industrial frequency of the earth connection

As a result, the compensated networks are reduced in duration an in amplitude in connection with the case of isolated neutral, and more that that, how much reactance coil are is accorded with the resonance.

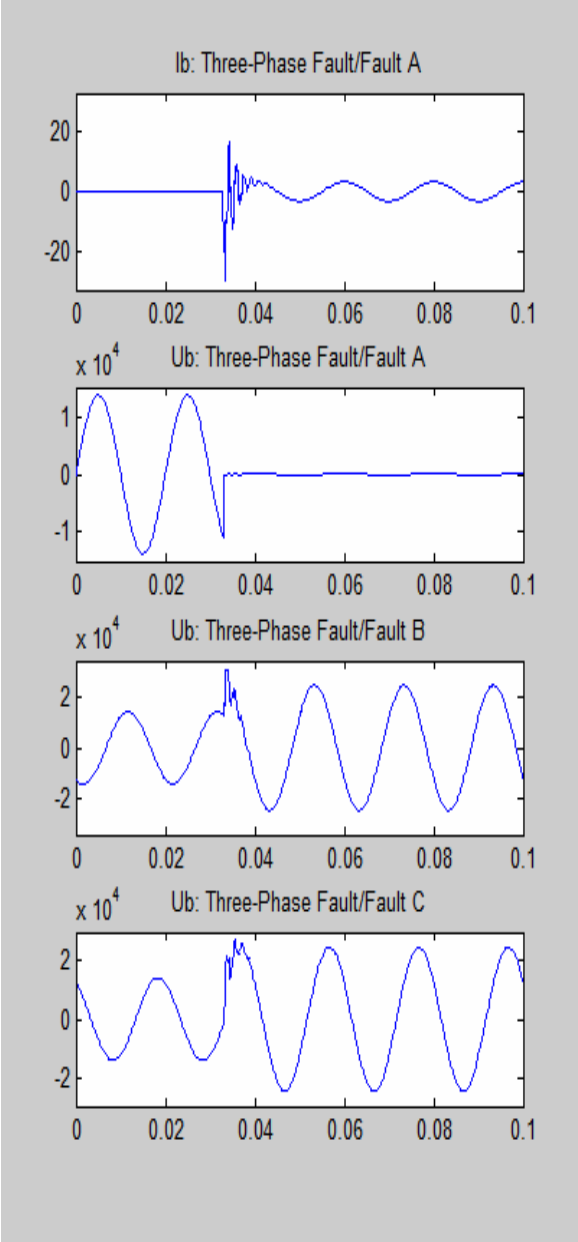

Figure 1: the tension and current in the single phase-earth fault on an isolated system

The great values of overvoltagess during the transition period of earth connections are a reason of isolation overvoltagess and poly-phased faults rising.

In the compensated regime big tensions appear, especially in the regime earth connection through the intermittent electric arc and selective protections selective and rapid absence. In fig. 2 tension and current curve are presented through a network of compensated neutral – as a result of modeling in SIMULINK. Overvoltagess in the transition regime result $U_{fm}/U_f = 2,08$.

2.3. Neutral earthing by resistance

This method of neutral treatment is not used in our country. At the same time from the experience of world practice the neutral treatment through resistance is the most attractive solution to treat the neutral.

Two ways of neutral earthing by resistance are possible: resistance of big ohm value and small ohm value. Resistance of high ohm value is chosen in such way that the current in the place of phase earth connection will be equal or higher than the capacitive current of the network. This will permit to eliminate the overvoltages of arc on one phase of earth connection. As a rule, the total current on the place of fault does not exceed the value of 10A, so, the fault network may still work. The neutral treatment through a higher resistance may be applied in the networks with low capacities and capacitive current till 5-7 A.

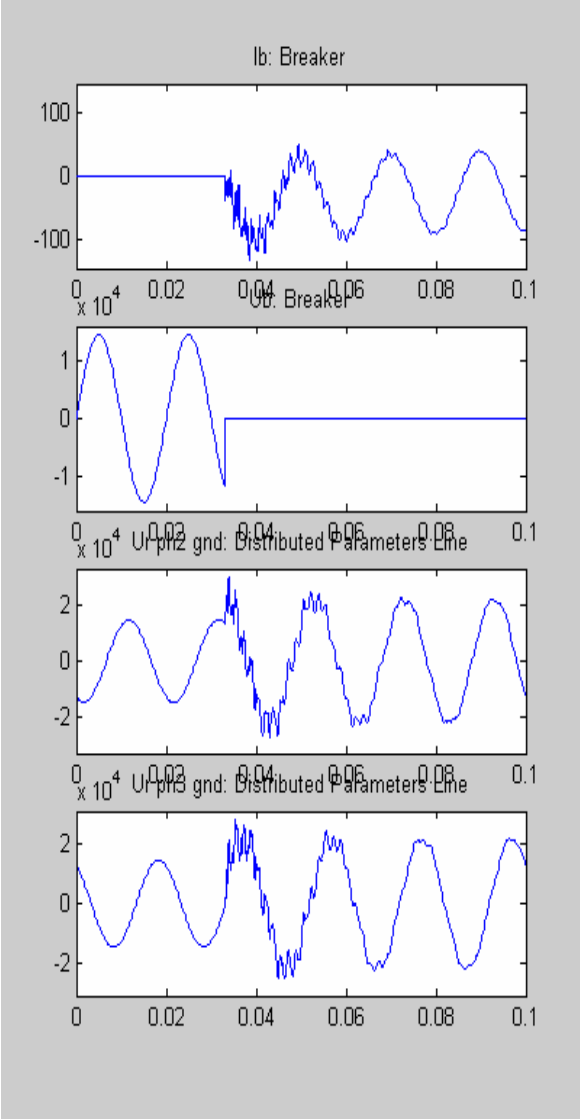

Figure 2: compensated neutral - phase-earth fault current and phase-earth voltage

The networks with high current capacities are used for treatment with resistance of low ohm value that create a current of 10-2000 A in the place of fault. In this case the protection works at non delayed disconnection of the one-phased short circuit, that will lead to the avoidance of consecutive faults (double or multiple) owing to the short time functioning.

An essential advantage of neutral treatment through ohm resistance consists in rapid amortization of free motion that may appear in the networks during the transition processes that accompany the short circuits with an electric arc. In fig. 3 the stress curves and current from fault in a network with a neutral treated through resistance – as a result of SIMULINK modeling are presented. . Overvoltagess in the transition regime result U_{fm}/U_f = 1,66.

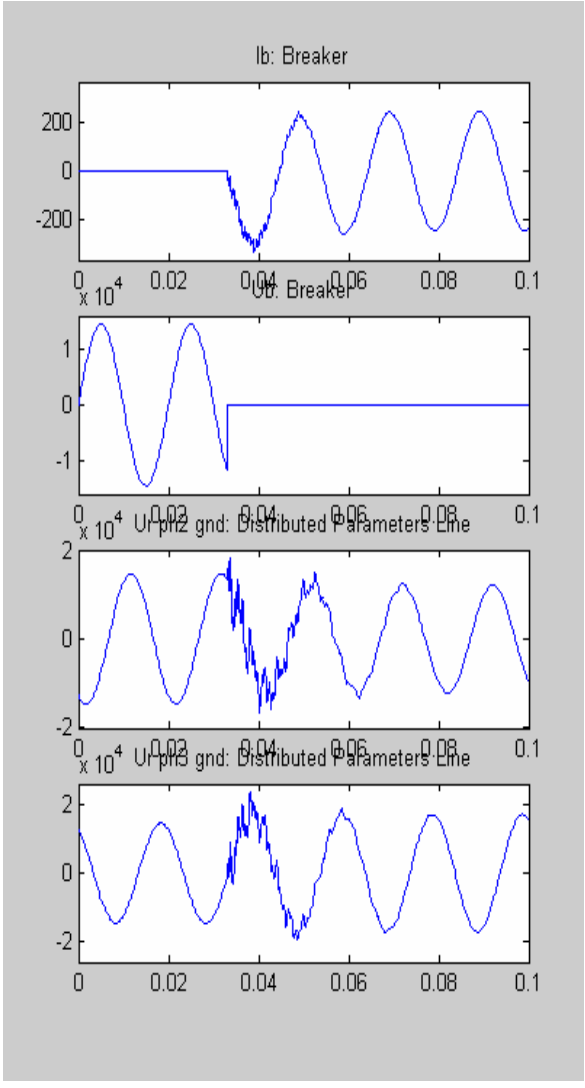

Figure 3: earthing neutral - earth fault current and phase-earth voltage

3. CONCLUSIONS

The choice of the neutral earthing of an electric network is a complex issue, related to many factors, of which determining as the behavior of the networks at earthing.

Analyses of the presented curves correspond to the above mentioned. On phase earth connection in the systems with isolated or compensated neutral dangerous overvoltages for isolation appear and it is necessary to study the rational method of neutral treatment in the networks of medium tension of the electrical power engineering of RM with the transition to a treatment through ohm resistance.

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