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DEVELOPMENT OF METHODS FOR DETERMINING THE CAPACITIVE INSULATION CONDUCTION IN THREE-PHASE NETWORKS WITH ISOLATED MIDPOINT NEUTRAL CONDUCTOR WITH VOLTAGE UP TO 1000V

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Annotation

In this paper we propose a new method for determining the capacitance isolation conduction. A new method based on the measurement of the absolute value of the voltage between phase and ground, and on the measurement of the absolute value of the current. Current flows through the additional capacity. Also given the specified empirical current.

The developed method provides acceptable accuracy, simplicity, safety during work on determination of the magnitude of capacitance isolation conduction in network.

Keywords: electrical network, isolation, current, voltage

Introduction

Phase insulation parameters of electrical network characterize the state of the system reliability of power supply system in companies. The conductance insulation of electrical network characterized the dielectric properties of the material. Capacitive susceptance of electrical network characterizes the extent of air-cable lines; the magnitude of susceptance is determined by the capacitive fault current of any electrical phase to ground, which is used to determine the setting of compensation devices. The total current of a single-phase earth fault can determine from the value of the admittance phase insulation of electrical network, which is necessary for the development of organizational and technical measures aimed at improving efficiency in the protection of single-phase ground fault, network ground, fighting with overvoltage [1].

Definition of capacitive isolation conduction in three-phase electrical network with isolated neutral allows providing increases in electrical safety and effectiveness of low-voltage power supply for power consumers.

Methods

In determining the capacitive isolation conduction in a network with isolated neutral voltages up to 1000 V used method for determining the current single-phase earth fault in networks with isolated neutral, which is based on the connection of additional capacitive conductivity between one phase electrical network and ground, using optional capacitive conductance between two other phases of the network, and measuring the current flowing through the additional capacitive conductivity, which is connected between one phase electrical network and ground, as well as the measurement of the current flowing through the additional capacitive conductivity, which is connected between the other two phases of the network, as long as connect additional capacitive conductivity equal:

$$I_o = \frac{I_1 I_2}{I_2 - 1{,}73 I_1}, \qquad (1)$$

where I_1 – current, flowing through the additional capacitive conductivity b_1, which is connected between electrical network phase and ground;

I_2 – current flowing through the additional capacitive conductivity b_2, which is connected between the other two phases of the network.

Determine the current single-phase ground fault in order to improve the accuracy, connect an optional capacitive conductivity between the other two phases of the electrical network is equal to 1.73 times the value of the additional capacitive conductivity, which is connected between electrical network one phase and ground.

In accordance with the above, the definition of single phase overcurrent to ground take form in ratio $b_2=1{,}73b_1$ by formula (1):

$$I_o = \frac{I_1 I_2}{I_2 - I_1}. \qquad (2)$$

Way to determine the single-phase overcurrent to ground in network with isolated neutral provides satisfactory accuracy, simplicity, safety in work to determine the required amount of current and does not require the manufacture of any measuring device [2].

The value of the capacitive isolation conduction in network is determined, according to Ohm's law, from equation (2) and is described by the expression:

$$b = \frac{I_1 I_2}{(I_2 - I_1) U_{ph}}, \qquad (3)$$

where U_{ph} – phase to ground voltage.

In this case, absolute value of current, flowing through the additional capacitive conductivity between the two phases of the network, is replaced by the empirical current $I_{em} = U_l b_2$, according to the ratio $b_2 = 1{,}73 b_1$ the absolute value of the line voltage U_l will be unchanged [2].

Based on the above, it follows that to determine the capacitive isolation conduction in three-phase networks with isolated neutral proposed a new method, where by the measured absolute values of the phase to ground voltage and the current I_c flowing through the additional capacity, given the specified empirical current I_{em}, value is determined by the capacitive isolation conduction in three-phase power supply with isolated neutral (I_1=I_c, I_2=I_{em}):

$$b = \frac{I_c I_{em}}{(I_{em} - I_c) U_{ph}}. \qquad (4)$$

According to this method, developed a method of determining the capacitive isolation conduction in three-phase electrical network with isolated neutral.

Method of determining the capacitive isolation conduction in three-phase networks with insulated neutral explained in electric scheme shown in Figure 1. The scheme contains:

- A, B, C – phases of the investigated network;
- Y - total admittances of network isolation;
- QF – disconnector;
- C – additional capacity, which is connected between one phase electric network and ground;
- PA – ammeter, which measures the amount of current flowing through the additional capacity C;
- PV - voltmeter to measure phase to ground absolute voltage.

To measure the absolute value of the current, flowing through an additional capacitance C, using an ammeter type E-515 with an accuracy of 0.5.

Definition of capacitive isolation conduction in three-phase electric network with isolated neutral made by the following procedure:

1. Selected reserve unit with load disconnector QF of switchgear 0.4 kV.
2. Performed testing of switch disconnector QF to efficiency.
3. For production works on preparation switching power circuits and measuring current circuits disable the load switch QF.
4. Between switch disconnector QF phase A and the ground is connected additional capacity C, which is connected in series with amp meter RA, one of the conclusions of which is connected to ground.
5. Between phase A and the ground is connected voltmeter PV to measure the absolute voltage between phase and ground.

6. After all the preparatory work referred to in paragraphs 1 ÷ 5, voltmeter PV measures the absolute voltage between phase and ground.
7. When the work on item 6 was finished the breaker load QF disconnecting in order to connect additional capacity C between phase A and the ground. And in order to measure the absolute value of current by amp meter PA. The current going through additional capacity C.
8. After registration of the absolute value of the current flowing through an additional capacitance C, produced tripping of the breaker load QF [3].

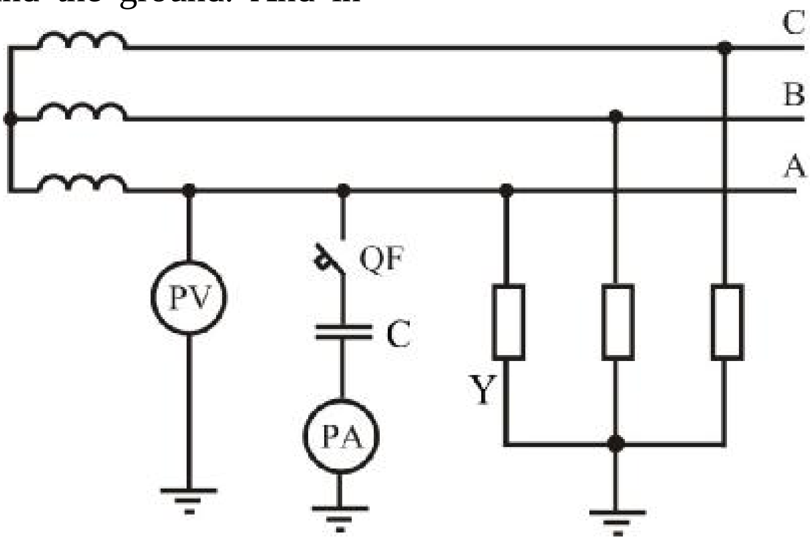

Figure 1 – Scheme electric basic of methods for determining capacitive conductivity of insulation in a network with isolated neutral

After measuring the absolute value of current, under paragraph 7, the value is determined by the capacitive isolation conduction in three-phase electrical network with isolated neutral by formula (1), where the value of a given empirical current is determined from Table 1.

Table 1 The values of the empirical current to determine the capacitive isolation conduction in three-phase electrical network with insulated neutral

Additional capacity C, µF.	0,2	0,4	0,5	0,6	0,8	1,0	1,2
Empirical current I_{em} , A.	0,024	0,048	0,060	0,072	0,095	0,119	0,143

Measurements are made in accordance with the safety regulations for operation of electrical installations by brigade of two electricians, qualifying group which is less than 5 at the head of the work, and not less than 4 at the second electrician.

Conclusion

The developed method provides acceptable accuracy, simplicity, safety during work on determination of the magnitude of capacitance isolation conduction in three-phase electrical network with isolated neutral. The developed method does not require the manufacture of a measuring device, since the necessary measuring devices are available in the service companies operating energy management.

Implementation of the developed technique allows for improvement the level of safety in companies which operate with voltage up to 1000 V.

References

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Резюме

В этой статье мы предлагаем новый метод для определения емкости изоляции. Новый метод основан на измерении абсолютного значения напряжения между фазой и землей, и на измерении абсолютного значения тока. Ток течет через дополнительной мощности. Также, учитывая точно определенную составляющую эмпирического тока.

Разработанный метод обеспечивает приемлемую точность, простоту, безопасность во время работы по определению величины изоляции емкости проводимости в сети.

Түйін

Бұл мақалада біз оқшаулау өткізу қабілетін анықтау үшін жаңа әдісі ұсыныламыз. Жаңа әдісі фаза мен жер арасында кернеу абсолютті құнын өлшеу жөніндегі, және ағымдағы абсолюттік маңызы өлшеуге негізделген. Ағымдағы қосымша билік арқылы ағады. Сондай-ақ, эмпирикалық ескере ағымдағы деді.

Өткізу желісін оқшаулау қуаты құнын анықтау үшін жұмыс істеу кезінде әзірленген әдіс қолайлы дәлдігі, қарапайымдылығын және қауіпсіздігін қамтамасыз етеді.

Summary

In this paper we propose a new method for determining the capacitance isolation conduction. A new method based on the measurement of the absolute value of the voltage between phase and ground, and on the measurement of the absolute value of the current. Current flows through the additional capacity. Also given the specified empirical current.

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