MEASUEMENT OF ELECTROSAFETY PARAMETER WHEN PROVIDING THE ELECTRIC POWERS ON BOARD THE SHIP FROM COAST

ИЗМЕРЕНИЕ ПАРАМЕТРОВ ЭЛЕКТРОБЕЗОПАСНОСТИ ВО ВРЕМЯ ЭЛЕКТРОСНАБЖЕНИЯ СУДОВ ОТ БЕРЕГОВЫХ СЕТЕЙ

Assist. Prof. Tugushi M.[1], Assist. Prof. Loria M.[2], eng. Karasiev B.[3], Assoc. Prof. Varshanidze F.[4] Assoc. Prof. Gogitidze G.[4]
Faculty of Technology Batumi Shota Rustaveli State University[1,2,3]-Batumi, Georgia,
Faculty of Maritime Engineering Batumi State Maritime Academy[4], Batumi, Georgia

Abstract: *The world market offers the greater nomenclature of the facilities for measuring parameters of electrosafety, as there is always a demand on them. The majorities of facilities do not guarantee accuracy or in general cannot value the measured parameter unless they do execute requirements and conditions of their operation. In particular, measurement of the resistance grounding device (GD), at resistivity of the soil more than 500 Ohm.m and in large concourse of the underground communication (seaports) requires the high qualification of the operator and large number of measurements. For instance, in the article unpinned way of measurements GD is considered based on measurement of phase voltages of network with deafgrounded of neutrality in connection with the investigation sidebar of the grounding device contour. The Offered way of the determination of the resistance GD, in basic range (0.1-10 Ohm) allows to value the garbled resistance GD with necessary accuracy.*

KEYWODS: *GROUNDING DEVICE, DEAFGROUNDED NETWORK, SEAPORT COMMUNICAITION*

1. Introduction

The Electric power worked out on ship, on prime cost vastly cherish electric powers, worked out powerful coast power station. When parking in port ship possible to connect to coast power system and remove their own generator units from work. In this case it is spared fuel and butters, withdraws the noise in engine rooms, is freed part personnel for repair work.

For presenting the electric powers on ship quays port must be corresponding to image are equipped with. The Difficulty consists in that in coast set of alternating current is mainly used three-phase system with grounded neutral, but on court zero point windings generator from body ship is insulated.

At connection of the ship power station to coast network necessary body ship safely to ground to exclude the electrocorrosion of the body [1] .

2. Preconditions and means for resolving the problem

At supply ship with use the three-phase transformer grounding vein of the ship cable serves for earth of the body ship.

While standardizing and designing the **grounding device** (**GD**) the probability of injuring person by electric current is taken into consideration. In no area of the technology and in general in real life it is impossible to provide full safety for people. Probability of the contiguity with dangerous voltages can be sharply reduced by careful design of GD.

The Distributing networks with nominal inter phase voltage of 380V execute the fourconducting and threeconducting. They are connected to networks with higher voltage through lowering transformers. Neutral of windings of the undermost voltage of the transformer is grounded. Its connected to grounded substations. Zero wire is grounded repeatedly.

The rates on GD require conditions, which they must satisfy [2]. The main are requirements, defining conditions of electrosafety.

For GD, used for grounding of the networks of the secondary voltage 380/220 B, potential GD must not exceed 125 B, but its resistance-4 Ohm.

To calculate GD - means to define potentials in any point of the space under given current, in particular potential GD, and also potentials in typical points of the surfaces of the land. The land usually is not of the same origin in composition and moisture content. Its resistivity changes when moving horizontally and in depth. As a rule, theoretical calculations without concrete measurements of resistivity of the soil, give greater inaccuracy, therefore results of theoretical calculation are used beforehand, on stages of the projection.

Available electroinstallations require periodic energo checkup, preventive maintenances and checking the requirements of electrosafety, periods of which are stipulated in acting documents. In Georgia the checking of the specified requirements must be produced much more often, since a big part of electroequiments has worked out its resource. The requirements of acting rules of the SAFETY and Rules to Technical Usage of Electromounting install the rates a parameters of electrosafety and periods their periodic checking, to which priority is given to:

1. The measurement of the resistance of insulation;
2. The measurement of the resistance of the loop "phase-0";
3. The measurement of the resistance of the grounding device.

The world market offers the greater nomenclature of the facilities for measuring parameters of electrosafety, as there is always a demand on them. These facilities, as a rule, measure the specified parameters separately that requires from buyer rather significant financial expenses (refer to, for instance, nomenclature of one of the world leader producing measuring instrument, company "Sonel" www.sonel.pl).

The majority of facitilities do not guarantee accuracy or in general cannot value the measured parameter unless they do execut requirements [3] and conditions of their operation. In particular, measurement of the resistance GD, at resistivity of the soil more than 500 Ohm.m and in large concourse of the underground communication (seaports) requires the high qualification of the operator and large number of measurements.

Sometimes resistivity soil outside of sidebar of the earth forms more than 500 Ohm.m (the utter asphalt, stony or sandy soil,…). Consequently it's necessary to jab in current and potential electrodes (the pin) soil enough deeply, but if it fails jab several pins, having connected them in parallel that is possible if there are not found power or high-tension cables in the earth. So we must be sure beforehand, that there are not such cases. In these cases, the determination of the site underground communication dispenses for the customer are more expensive, than measurement of the resistance of the earth itself. Here it's impossible to measure only. For reception of the reliable result it is necessary to do as minimum several measurements and if their results differ more than 10 %, continue driving the pins in the other place.

At first thought this is an exclusive matter, but practically we come across it often, in the seaport and particularly in the central part of any big city.

The conclusion is one: alternative unpinned ways of measurements of the resistance of the grounding are necessary.

Such works have already been carried out, however they are found at a rate of patent and recommendation moreover majority of them are insufficient to provide the main range of the measurements (0.1-10 Ohm) with necessary accuracy (5-10 %).

3. Objective and research methodologies

We Offer our variant of measurements of the resistance of the grounding, in basic range of the measurements (0.1-10 Ohm) [4].

The main idea is such a: If on zero wire (N) two equal opposite phase of the current, are passed the fall of the voltage on it will be equal to zero regardless of resistances of the zero wire (Z_0).

Let's consider the most simplest electric circuit (fig. N1) of the passing of the current of the load (In), under its connection between phase and zero in single-phase network with deafgrounded of neutrality of the power transformer.

Assume, we have measured the voltage on load (the points 2;3)-Un, and without it - Uxx under given resistance of the load Z_{23}. We shall define how far will the voltages Un and Uxx differ.

$$U_{xx} - U_n = \frac{U_n}{Z_{23}} \cdot (Z_{01} + Z_{12} + Z_{03}) \qquad (1)$$

If we connect point 3 with grounding device GD, the expression (1) will look like:

$$U_{xx} - U_n = \frac{U_n}{Z_{23}} \cdot (Z_{01} + Z_{12} + \frac{Z_{03} \cdot Z_{GD}}{Z_{03} + Z_{GD}}) \qquad (2)$$

From (2) follows that any GD of the load reduces the fall of the voltage to network and promotes the increasing of electrosafety.

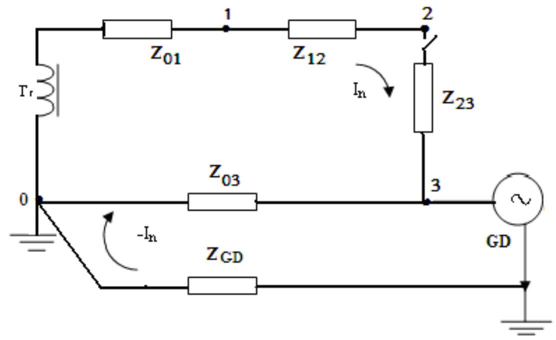

Fig. N1. EQUIVALENT SCHEMES to SINGLE-PHASE NETWORK UNDER LOAD

Tr-supplying transformer; Z_{01}-internal resistance of the transformer; Z_{12}-resistance phase wire; Z_{23}-resistance of the load; Z_{03}-resistance of the zero wire; GD-separate sidebar of the earth (grounded device); Z_{GD} - a resistance grounding network.

Assume, that between point 3 and GD we shall connect the power source with the known voltage U_2 moreover we select it in such a way, that contour current (the contour GD, 0, 3, GD) was equal to a current of the load and inverse on direction, then equality is fair:

$$U_2 = U_n \cdot \frac{Z_{GD}}{Z_{23}} \qquad (3)$$

From which follows that in this case it is possible to define the resistance of the grounding Z_{GD}, regardless of the resistances of the zero wire:

$$Z_{GD} = \frac{U_2}{U_n} \cdot Z_{23} \qquad (4)$$

If we measure not voltage (Un), but current of the load (In) (for instance, current mite), that expression (4) is simplified:

$$Z_{GD} = \frac{U_2}{I_n} \qquad (5)$$

Inaccuracy of the measurement of the resistance GD will depend on inaccuracy of the measurement of the voltage and current moreover if their relative inaccuracy are equal or close, then resistance GD will be calculated maximum exactly:

$$\frac{\Delta Z_{GD}}{Z_{GD}} = \frac{\Delta U_2}{U_2} - \frac{\Delta I_n}{I_n} \qquad (6)$$

But must not be forget about that concourse of the voltage has its own (internal) resistance so under responsible measurements (for instance, under normalized importance of the resistance GD less 0.5 Ohm) it is necessary to take into account.

It is enough to measure the resistance of the concourse of the voltage once to hereinafter if required, correct the results of the measurement GD, entering corresponding adjustment.

The essence of the second method is that the method of measuring the resistance of the earthing switch in a network with a blindly grounded neutral provides for the transmission of the load current included between the phase conductor and the earthing switch and the determination of the desired parameter on the basis of the magnitude of the current flowing through the load. In addition, the load current is branched in two potentiometers with the formation of one of the nodes of the measuring bridge circuit composed by these potentiometers together with the zero wire and the required earthing resistor; The first potentiometer is connected to the neutral wire, and the second - to the earthing switch; the balance of the bridge is monitored by means of a zero indicator connected to the diagonal of the bridge between the earthing switch and the first potentiometer. The resistance of one or both potentiometers is adjusted until the bridge is balanced, and the resistance of the earth electrode is determined taking into account the ratio of the resistance of the potentiometers at the moment of bridge equilibrium.

FIG. 2 is an electrical circuit for explaining the nature of the proposed method for measuring the resistance of the earthing switch. The source of a single-phase network of an industrial frequency (50 Hz) is shown which, via a phase conductor with resistance Rc, through a load resistor Rz is connected to a measuring bridge circuit whose arms are formed by potentiometers R1 and R2, zero wire with resistance Ro and the required resistance of the earthing switch Rx.

For the indicated measurement scheme, the equilibrium condition of the bridge has the form:

$$\frac{R_2}{R_x} = \frac{(1-K)\cdot R_1}{R_0 + K\cdot R_1} \qquad (7)$$

where K is the known part of the resistance of the potentiometer R1.

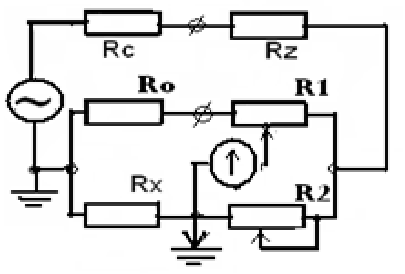

Fig. 2

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From the relation (7) it follows that the resistance of the zero wire Ro participates in the measurement of the resistance of the earth electrode Rx, but if the resistance of the potentiometer R1 is chosen, for example, three orders of magnitude greater than Ro, then it can be neglected.

In view of this

$$R_x = \frac{K}{(1-K)}\cdot R_2 \qquad (8)$$

that is, a direct measurement of the resistance of the earthing switch is provided.

4. Conclusion

Various variants of the device for implementing the proposed method for measuring the resistance of the earthing switch are possible, for example, the use of bridge arms with a close inductive coupling (transformer bridges), the use of resistive, capacitive bridges and bridges of other types.

The Offered way of the determination of the resistance GD, in basic range (0.1-10 Ohm) allows to value the garbled resistance GD with necessary accuracy.

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